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President Conant of Harvard, who testified before the Interstate and Foreign Commerce Committee of the House of Representatives on March 7. Dr. Conant's testimony is printed in full in this issue.

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National Science Foundation Testimony

William C. Foster, James B. Conant, and Vannevar Bush

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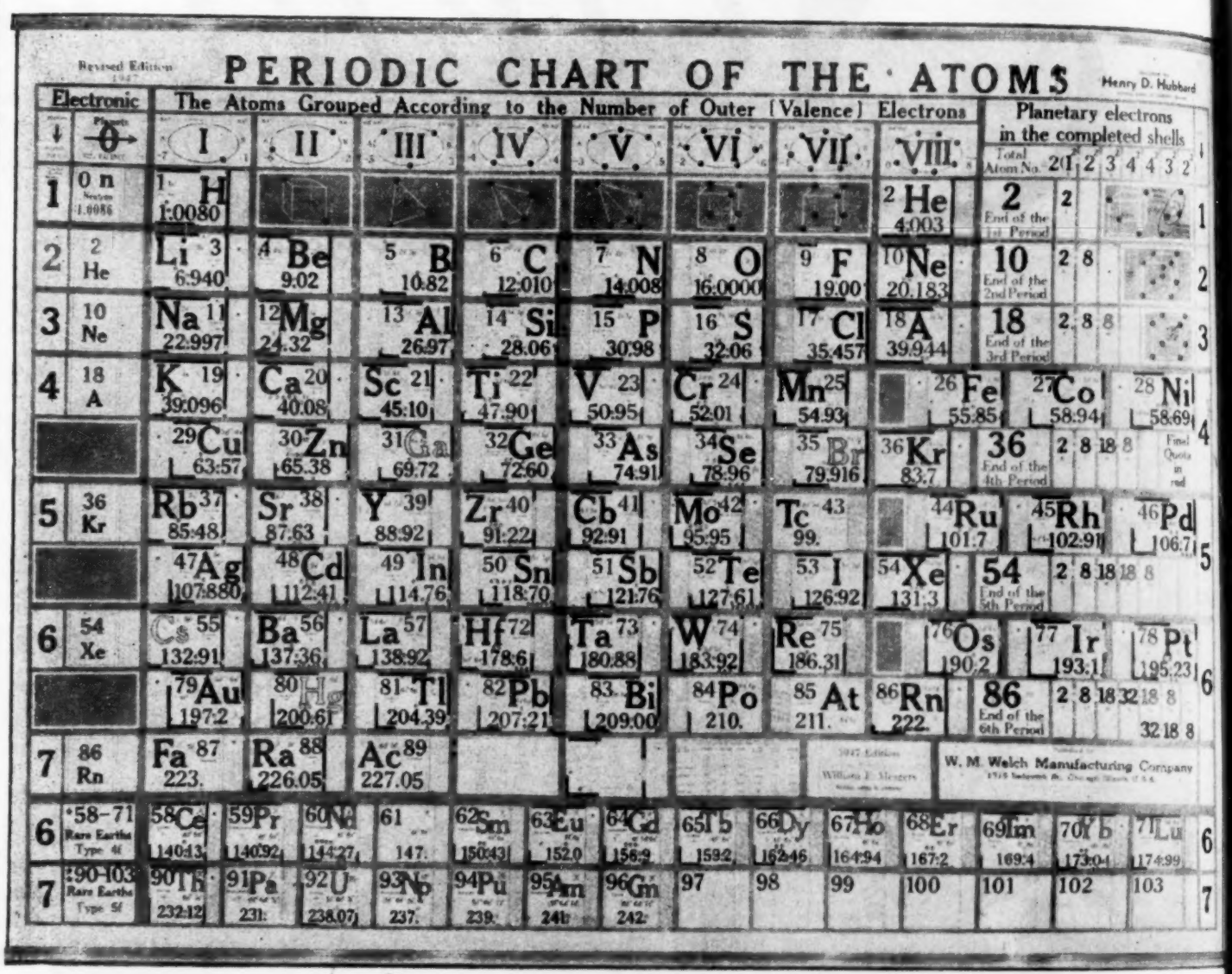

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Science

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A National Science Foundation

Statement by William C. Foster, Under Secretary of Commerce, before the Committee on Interstate and Foreign Commerce, House of Representatives, March 7, 1947

THE PRINCIPAL DIFFERENCES BETWEEN the bills before Congress for a National Science Foundation relate to: (1) the form of administrative organization of the proposed Foundation; (2) the question of patent policy with respect to government research contracts; (3) the inclusion of the social sciences; and (4) the distribution of research funds.

Administrative Organization

The difference of opinion as to the form of administrative organization of the proposed Foundation is fundamentally between the following two principles: (1) the usual straight-line organization of Federal agencies consisting of an administrator appointed by the President with the advice and consent of the Senate and responsible to the President; and (2) a part-time board of private citizens which in turn selects a full-time administrator. In the bill which passed the Senate last year a combination of these two administrative arrangements was agreed to—a Presidentially appointed administrator supplemented by a part-time advisory board and divisional advisory committees with the right to report to the President and the Congress independently. H.R. 942 also provides for this in-between arrangement.

On the other hand, the four other bills before your Committee represent an extreme form of the part-time board arrangement. Instead of the board of 9 members in the Magnuson and Mills Bills of last year, these four bills provide for an uncompensated part-time board of 48 members appointed by the President. This large board then selects an executive committee of 9 members, which in turn chooses the director of the Foundation. The executive committee in effect exercises all the real duties and powers of the Foundation. In fact, the 48-man board seems to have no other function than to establish the executive committee and to ratify by majority vote the selection of the director of the Foundation by the executive committee.

I should like to make two observations about this wheels-within-wheels arrangement which starts with a 48-man, part-time committee.

First, if the President or the Congress were dissatisfied with the workings of the Foundation, it would be practically impossible to focus responsibility and to bring about any change in policy under this kind of arrangement. The director could hide behind the executive committee and the executive committee behind a board with 8-year terms.

Second, this 48-man board might also be construed as a bargaining device. Since the board has few functions, it could easily be "sacrificed" in a compromise with the principle of a single administrator, leaving a 9-man board which exercised all of the functions anyway. A compromise on this basis would be similar to the well-known fifty-fifty horse and rabbit stew—one horse and one rabbit.

It seems clear, then, that the practical choice boils down once more, as it did last year, to first, a part-time board of about 9 members selecting its own director, or second, an administrator appointed by the President with the advice and consent of the Senate. Or another alternative is the genuine compromise between these two positions contained in S. 1850 last year and H.R. 942 this year, which consists of an administrator plus an advisory board with direct access to the President and to the Congress. In my opinion there is no question that the basic principle of the single administrator advocated by President Truman represents the only sound public policy. The amount of influence on American scientific development which could be exercised by the Foundation, and the volume of public funds which will be allocated by the Foundation, are too great to give to a part-time body of private citizens. This is especially true if complete discretion is given to the Foundation—as in the four almost identical bills before you—to allocate research funds without regard to geographical distribution or type of research institution. We have here a situation in which a small group of men without direct responsibility to the elected representatives of the people—the President and the Congress—could control the public financial support of science outside the framework of our recognized democratic procedure of coupling responsibility with authority in government. Authority without responsibility is basically wrong in principle.

Patent Policy

On the question of patent policy all the bills before you are in agreement that no employee of the Foundation shall be permitted to profit personally by taking out private patents on discoveries arising in the course of his employment with the Foundation. This is also the policy of the Department of Commerce and of most government agencies at the present time with respect to employee patents.

On the other hand, when it comes to applying the same principle to research contractors using government

funds, the bills diverge. The four similar bills state that the Foundation shall "protect the public interest and the equities of the individuals or organizations" with which contracts are made without in any way defining the public interest. On the other hand, H.R. 942 provides that discoveries, including patented discoveries, arising in the course of all Federally-financed research shall be available to all, except that research contractors may in exceptional cases retain patent rights in fields where the contractor has made substantial previous investments of his own funds. It should be noted that H.R. 942 (and S. 1850 which passed the Senate last year) extends the public dedication policy to *all* Federally-financed research and not merely to the research financed by the National Science Foundation.

The question of patent policy is a separable question; it affects all government departments and not only the proposed Foundation. It is the subject of a very detailed and careful study by the Attorney General which has recently been submitted to the President for consideration. It is also a subject of study by the President's Patent Committee. Therefore, I suggest that the question of broad patent policy on research contracts be omitted from this bill so as to expedite its consideration and passage; and that government-wide patent policy be considered as a separate problem.

Social Sciences

There was, as you know, a considerable difference of opinion in the hearings last year as to whether the social sciences should be included in the National Science Foundation. Because of the similarity of terms, social science has carried an unfortunate connotation of social welfare activities or of a vague impracticability. Actually, social science, under more specific terms such as statistics, business analysis, and industrial psychology and management, is an indispensable tool in the operation of any modern large-scale private enterprise and in the operation of Federal, State, and local governments. The Congress itself has acted on this understanding in some of the provisions of the Legislative Reorganization Act of 1946, especially with respect to providing professional staffs to the standing committees.

Social science, however much it may be misunderstood when referred to in that general term, is a part of our everyday life in the 20th Century. We need more and better knowledge about our society if we are to be successful in dealing with some of the complex and difficult problems which we are facing today and in the years ahead. As to the kind of research to be fostered by the Foundation in this field, the Congress will, of course, be able to guide and control this matter through the review of annual appropriations, as it has done in connection with the extensive applied social science activities which have long been part of the operations of other Federal departments and agencies.

Developments in the natural sciences are far in advance of mankind's ability to control the physical forces which they have unleashed—such as atomic energy. As an engineer who has witnessed the impact of technological changes on our society, I am particularly aware of the importance of developing the sciences that deal with man and his institutions. In fact, the future of our society and of man himself may depend on whether we gain sufficient social knowledge in time to control the powerful forces of nature as they have come to be applied. A National Science Foundation which would provide only for the natural sciences would place the social sciences at new and further disadvantages in competing for the best young talent of the country in institutions of higher learning and in research.

Distribution of Research Funds

H.R. 942 contains a formula under which 25 per cent of the research funds (except for national defense research) of the Foundation would be allocated to land-grant colleges and state universities—15 per cent in proportion to the population of each state and 10 per cent in equal shares to all states. However, no individual contract can be made unless it is consistent with the general program and standards of the Foundation. Another 25 per cent of the research funds would be earmarked for nonprofit institutions. The other four bills provide no such guide to the Foundation in the distribution of research funds.

Under practically all legislation providing Federal aid to states there are rather rigid formulae for the distribution of funds—formulae based upon population, area, matching of funds, and various other objective factors. Very little discretion is left to the administrative agencies. The research funds to be allocated under this legislation are not, of course, strictly comparable with Federal aid to the states. On the other hand, some of the same considerations are applicable. Scientific ability is widely enough distributed among the various areas of the United States so that one-quarter of the Foundation's research funds can be expended according to a geographical and population formula without much danger of lowering the quality of research. At the same time such a provision provides some safeguard against the possibility of unnecessary concentration of funds in a few favored institutions. Similarly, it is only proper that the Congress provide some guide to the Foundation on the amount of funds to be allocated to nonprofit institutions, which have hitherto carried the burden of the basic scientific research with which this legislation is concerned. I would urge that your Committee give serious consideration to incorporating into the bill certain minimum standards for the allocation of funds, and yet leave sufficient flexibility so that the quality of research is maintained at the highest level.

Other Provisions of the Bills

I believe that the four points just discussed cover the most important variations in the bills which you are considering. In most other major respects the bills are substantially the same. I am glad to note, for example, that all the bills provide for the coordination of the scientific activities of the Federal Government through a standing Interdepartmental Committee on Science, and that the existing scientific agencies of the Government may receive research contracts from the Foundation as a supplement to their regular activities and appropriations, and not in substitution therefor. These two provisions are of great interest to the Department of Commerce, which includes several of the important scientific agencies in the Government, such as the National Bureau of Standards, Weather Bureau, and Coast and Geodetic Survey in the natural sciences, and the Census Bureau and Bureau of Foreign and Domestic Commerce in the social sciences.

In conclusion, let me say that the general objectives of this legislation have the fullest support and endorsement of the Secretary of Commerce, for whom I am speaking, and of the President. (I am, of course, in no sense committing the President on all the specific points I am raising.) On the other hand, there is serious question as to whether the Foundation could operate properly and in the public interest under some of the forms of administrative organization which have been proposed. The combination of the best features of the single administrator and an advisory board which were worked out last year, and which are incorporated in H.R. 942, seem to be the desirable solution of this problem. With respect to the social sciences and the allocation of research funds, the provisions of H.R. 942 also appear to be preferred to those of the other bills. Finally, it is my judgment that the patent prob'em is a separable issue and that government-wide patent policy should be considered independently of the Science Foundation Bill.

It has become increasingly recognized that widespread support of science is essential to technological advance, economic progress, and higher standards of living and to our national security. There is no question but that the public financial support of science which you are considering will in the long run represent a small expenditure compared with the great gains which experience has shown we may confidently expect.

A National Science Foundation

Statement by James B. Conant, president of Harvard University, before the Committee on Interstate and Foreign Commerce, House of Representatives, March 7, 1947

I APPEAR BEFORE YOU TO URGE FAVORABLE action on identical bills H.R. 1815, 1830, 1834, and 2027, which are concerned with a National Science Foundation. I wish to address myself at the outset to those sections which empower the Foundation to grant scholarships and fellowships. For to me these are by far the most important parts of the bills. I make this statement advisedly, for there is no use considering ways and means of spending money on research unless first-rate men are available to do the work.

In all the discussion about research that goes on in these days, an obvious fact is sometimes overlooked, namely, that it is men that count. And today we do not have the scientific man power requisite for the job that lies ahead. The bottleneck of our scientific advance is essentially a man power shortage, and unless something is done about it, the bottleneck will be more constricted a decade hence. Now let no one imagine that, like some of the man power shortages in the war, this can be cured by mobilizing and training for a short time the first people who come to hand. Scientific and technical advances depend on quality as well as on quantity or, to put it another way, on the quantity of exceptional men. These men have to be located when they are young and then given a long and expensive scientific education. If the proposals before you become law and Congress appropriates the money, we will see a flowering of scientific work in this country the like of which the world has never seen before. For only in this Nation, where universal education reaches to the high school level, is it possible to locate the hidden reservoir of talent which, if tapped, can enrich our life and that of all mankind.

The bill before you provides for a long-term plan. The measures proposed would have been desirable even if there had been no war and no consequent deficit in our scientific and technical man power. To the extent that we fail to cure this deficit in the next few years by proper governmental action, to that extent a Federally-supported scholarship and fellowship program is even more essential.

The arguments in favor of Congress providing for such a program and making adequate annual appropriations can be summarized as follows:

(1) The welfare of a free society in an industrial age depends on a continuous advance of science and the application of the new knowledge to useful ends.

(2) Both the advance of science and the application of science to industry, to medicine, and to agriculture depend on the quality and quantity of scientists and engineers available in a nation.

(3) The supply of men depends on the number trained and the innate ability of those who undertake the special training.

(4) The scientific professions in question require a long and expensive education beyond high school.

(5) This education is of such a nature that it can be given at only a relatively few centers in every state.

(6) Therefore, unless a student lives in one of these centers, his professional training must be costly for he must pay for room and board away from home as well as other expenses.

(7) The consequent financial barrier now prevents many boys and girls of high ability from going on with an advanced education. Much talent is lost to the Nation by this educational waste.

(8) To right the balance, a Federally-supported scholarship and fellowship program is required.

Such is the argument in a few words in terms of the peaceful development of the country. When we turn to consider the possible contingency of war and measures for national defense, the argument for finding and developing scientific talent is even stronger. There is no longer any argument about the role of science in a defense program. If we are to remain strong from a military standpoint, as I believe we must until international agreement provides a reasonable plan of disarmament, our need for scientists is as great as our need for Army and Navy officers. A relatively few men of great ability, imagination, daring, and with the proper training as officers of the armed forces have more than once in history determined the fate of nations. A relatively few men of great scientific ability and imagination, and thoroughly trained, can play a part in building the military strength of this Nation in the next decade to a degree that can hardly be imagined by those who are not close to the research and development program of the Army and the Navy.

Granted that in terms of the industrial development of the Nation, in terms of public health, and above all in terms of military strength, we must find and train our scientific talent, you may ask why a Federally-supported program of scholarships is required. I wish that all who raise this question could take the time to read the last section of the document entitled, *Science: the endless frontier*. The answer to the doubting Thomases is there set forth in detail. I shall endeavor in this statement to give only a brief summary of the important points.

The facts presented in that report and in other documents prove convincingly that we have been to a large degree wasting our most valuable national asset—the innate ability of each new generation. Table III on page 165 of *Science: the endless frontier*, for example, illustrates what every educator who probes deeply into this matter knows, namely, that *outside of the university towns and cities*, whether a student attends college or not is very largely a matter of family income. The figures quoted in this table refer to the college attendance just before the war of *superior* Milwaukee High School graduates (note the adjective, please). Here it is shown that while 100 per cent of those whose families had an income of $8,000 or higher attended college, the figure dropped to 44 per cent for the income range, $3,000–$2,000, and to 20 per cent for those under $500. These percentages are not for the entire class—far from it. These are the *superior* graduates of the high school—all college material. Similar evidence has been obtained by many other studies. I believe it is a conservative estimate to say that before the war there were as many boys and girls of real ability who graduated from high school but who did not attend a college as there were students of the same ability going on for further education. Once the veterans' educational benefits are over, the same situation will reoccur in this country unless steps are taken.

Let me remind you of what the report calls "The Educational Pyramid." This is an attempt to give an over-all statistical picture of the present educational selection in the United States; it represents the average for the whole country.

Starting with 1,000 pupils enrolled in the fifth grade (figures for earlier grades are confusing because of pupil retardations), the following figures show the extent to which they are reduced in each successive year:

Elementary school:	
Fifth grade, 1930–31	1,000
Sixth grade	943
Seventh grade	872
Eighth grade	824
High school:	
First year	770
Second year	652
Third year	529
Fourth year	463
Graduates, 1938	417
College:	
First year	146
Graduates, 1942	72

Now there are many reasons why boys and girls drop out of school, but there can be no question that to a large extent financial considerations play a part. This is particularly true in regard to the drop from 417 graduates of high school (per 1,000 of fifth graders) to 72 graduates of college. To the extent that family finances are the determining factor, potential professional talent is lost for the service of the Nation.

There is one very important point which I should like to emphasize in connection with the proposals I am urging today. We are concerned here only with the advanced education beyond high school of certain types of professional men and women; we are not concerned with

the problem of education beyond the high school in general. I am not advocating a Federal subsidy so that everyone can go to college—not even everyone who under our present standards can get by the entrance examination boards. The question of expanding public education beyond the high school for vast numbers is an entirely different story. As I see it, the pattern for public education in the future will be that of expanding the opportunities for education beyond high school as far as possible locally; that is, through institutions somewhat similar to those we now call junior colleges, two-year terminal institutions. This is the economical way to provide so-called higher education at public expense, for the student lives at home.

But there are certain types of education which cannot be given in every small city or town. They require very specialized staffs, expensive laboratories, large libraries. Training for these professions is the work of the universities or, in the case of engineering, the universities and engineering schools. To attend these institutions the poor boy needs support. It is in the interests of the Nation to give him this support. For the reasons I gave at the beginning of these remarks, it is imperative that this be done in the case of the future research worker in physics, chemistry, and biology, and the future engineer.

I hardly need remind this Committee that Congress, in considering the recruitment and training of naval officers, recently recognized the educational situation which I have just explained. By the adoption of the Holloway Plan the Federal Government has equalized the opportunity for college education for a limited number of talented youth from low-income families if they are enrolled in the NROTC units. Authorization was given, I believe, for 14,000 regular students in NROTC units in 52 colleges and universities. The cost of tuition, fees, and textbooks will be paid by Federal funds. Uniforms will be provided, and students will receive retainer pay for other expenses during college at the rate of $600 a year. Undoubtedly, a great many very promising young men will obtain a college education in this manner who might otherwise have received little or no training beyond high school. The recruiting and education of the regular Navy and Reserve Officers will be facilitated. On both counts the welfare of the Nation is promoted. I congratulate Congress and the Navy on the adoption of this plan. But measured solely in terms of our military strength, can the Nation afford not to adopt a somewhat similar scholarship program for the scientists? If you envisage the nature of our present and future armaments as I do, you will agree that the need for outstanding scientists is comparable to the need for naval officers.

The type of young man who should and will apply for the Navy program, by and large, will not be the type who would benefit from the Federal scholarship program I am advocating. The Navy needs, for the most part, future operators, men of action and decision. But the mechanisms they operate must be designed by research and development men, and the work of those applied scientists in turn rests on the discoveries of the pure scientists. The bill I am supporting, of course, provides for no counterpart of the NROTC. And none is needed. The recipients of the scholarship would be free to choose their own college or university. Fortunately, it is no longer necessary to argue that a good selection can be made from among the high school graduates of the country. This has now been demonstrated by our war experience and is a premise of the Holloway Plan. The same type of nation-wide aptitude test now used by the Navy would be used with perhaps a somewhat different slant. Final selection, as in the Holloway Plan, might well be in the hands of State Selection Committees.

All the details of administration should be left to the Foundation and its officers, as the bill quite properly does. However, I think that provision of Section 9 (a) is wise. It provides "that the Foundation shall award the available scholarship or scholarships or fellowship or fellowships to the applicants in such manner as will result in a wide distribution of scholarships and fellowships among the States, Territories, possessions and the District of Columbia." I am inclined to think that the administration of the scholarships might, if the Act permits, be along the lines indicated in the document to which I earlier referred. For example, on page 146 of *Science: the endless frontier* is given an allocation of the proposed 6,000 scholarships a year on a state basis. I believe this recommendation or an approximation to it would be sound national policy for two reasons:

(1) It emphasizes local administration, which I think highly important in all educational matters.

(2) It will stimulate the educational development of many states which do not at present contribute their share of talent. We should recruit our professions more uniformly from the country and by so doing stimulate talented young people in more sections of the country to take the necessary advanced education which is required. At present our research scientists are drawn in large measure from a relatively few states. That is not a healthy situation. I believe a Federal program of scholarships for certain professions administered on a state quota basis would in a generation change this picture. It should be understood, of course, that the recipient of the scholarship could enter any institution he chose. The universities within each state would then have to compete for the Federal scholars both within and without their region by giving as good scientific and professional training as could be obtained anywhere in the country.

The scholarship and fellowship program set forth in *Science: the endless frontier* called for 6,000 scholarships annually awarded for four years to high school graduates —a total of 24,000—and a total of 900 graduate fellowships. The maximum annual total cost of the plan, it was

estimated, would be $29,000,000 after the fourth year of operation. Although I do not think this amount of money too large in view of the paramount importance of the Federal scholarship plan for scientists in terms of the national welfare, I do recognize the need this year of keeping Federal expenses down. I therefore suggest that the number of scholarships and fellowships might well be set at half the figure I have just given. I should not advocate writing this or any figure into the bill. I assume the matter would be handled in connection with the appropriation which must be made if the bill becomes law. A total expenditure of somewhere around $14,000,000 for the plan when it is in operation seems to me reasonable, particularly when one remembers that this will provide for fewer scholarships (12,000) than the number authorized under the Navy plan, which calls for a maximum of 14,000. There is no doubt in my mind that a program of the dimension I have just mentioned would be very worth while indeed. If such a scheme could be operated for five or six years, ample evidence would be accumulated to enable Congress and the American people to assess the value of the plan.

Now, in conclusion, may I once again endorse the whole proposition—the establishment of a National Science Foundation as specified in the legislation I am supporting. I have confined my remarks to the scholarship program because I believe it is of the first importance. But the other features of the bill—the graduate fellowships and the support of research—are likewise of great significance for the future welfare of the Nation. I venture to hope that your Committee will report favorably on this matter and that the Senate will in due course take similar action. We need a Science Foundation both to forward our domestic economy and to strengthen our military establishment.

A National Science Foundation

Statement by Vannevar Bush, Chairman, Joint Research and Development Board, before the Committee on Interstate and Foreign Commerce, House of Representatives, March 7, 1947

THIS STATEMENT HAS BEEN SUBMITTED to the Bureau of the Budget, although time has not been sufficient to permit a reply. I want to make it clear, therefore, that I do not purport to represent the opinion of the President.

It is quite unnecessary for me to take up your time with an argument tending to prove that our economic and industrial progress, our national security, and our national health and welfare are dependent on continually extending that knowledge of our environment which comes only from basic scientific research.

It is equally unnecessary to make a lengthy argument that the time has come for the Government to intervene in support of basic research. The devastation of a large part of Europe has effectively eliminated many of our principal sources of fundamental scientific knowledge. Within the United States, our principal sources have always been the nonprofit educational institutions and endowed foundations. These institutions now are faced with increasing costs and decreasing income. We must, therefore, replace the lost sources of new scientific knowledge and strengthen those which we still have.

I believe that these statements reflect the views of most of the scientists, educators, and industrialists in the United States. In the last session your Committee heard a number of leaders in these fields testify to that effect. Committees of the Senate heard the testimony of well over a hundred such leaders. With one exception, all of those who testified before committees of Congress on science legislation supported the proposition that the Government must undertake the support of basic scientific research.[1]

Now, the witnesses at those hearings differed rather widely in their views as to precisely what action the Government should take, how far it should go, and what kind of instrumentality should be established to take such action. Several bills were introduced in the 79th Congress, and there were many drafts and redrafts of some of them. In addition, there were many discussions and conferences between interested scientists and educators, and members of Congress. In the course of these discussions the various divergent views were analyzed, and many of the differences were reconciled. The issues were thus narrowed so that you now have before you only two different bills, H.R. 942 and H.R. 1830. Since H.R. 1815, H.R. 1834, and H.R. 2027 are identical, I shall refer to them collectively as H.R. 1830.

Now, both bills have many desirable objectives in common. They both establish a National Science Foundation as an independent agency. They both provide that the Foundation should support basic research. They both provide that, with respect to matters affecting the

[1] See the record of the Hearing before a subcommittee of the Committee on Interstate and Foreign Commerce, House of Representatives, 79th Congress, 2nd Session, on H.R. 6448 and of the Hearings on Science Legislation before a subcommittee of the Committee on Military Affairs, United States Senate, 79th Congress, 1st Session, pursuant to Senate Resolution 107 (78th Congress), and Senate Resolution 149 (79th Congress).

national defense, the Foundation may not only support basic research but also perform applied research and development. They both provide for the award of scholarships and fellowships in science, to young men and women of outstanding ability, and neither bill attempts to limit the recipients to any particular field of scientific study or to retain any control over them after completion of their studies. Both bills contemplate an internal structure for the Foundation composed of divisions, each of which is to be concerned with a major field of science, and in addition, a division of scientific personnel and education. Moreover, they both permit additional divisions to be established when necessary or desirable. Both bills provide for an advisory committee of specialists to be attached to each division. Both bills provide for correlation of existing government research activities. Both bills provide for international cooperation in research and for fostering the interchange of scientific information, both domestically and internationally. Several other provisions which these bills have in common give to the Foundation special authority and certain exemptions from existing provisions of law. These provisions recognize the unique nature of the Foundation and will greatly facilitate its operations. I need not go into detail as to why all of these objectives are desirable and necessary, but I would like to point out and analyze the principal differences between the two bills.

The most important of these differences is the locus of ultimate authority and responsibility within the Foundation. H.R. 942 vests this authority and responsibility in a single administrator who would act with the advice of a part-time board. On the other hand, under H.R. 1830 the Foundation would be headed by a board of outstanding men, which in turn would appoint an administrator to carry out its policies and to handle the administrative affairs of the agency.

Now, it has been the experience of the Government that when commissions or boards attempt to handle operational details, they are very apt to run into difficulty. Disagreements among the members can cause lengthy delays. Conflicting orders may be given by the several members, and disputes and hard feelings can arise over matters of administrative detail. I do not feel, therefore, that a commission or board, as a group, should be directly active in the actual operations of an agency. But there is no reason whatever why this should occur. Several government agencies which carry on extensive operations, as opposed to performing quasi-judicial functions, are organized on the basis of reposing the ultimate control in a group of men. As a matter of fact, I have had a good deal of experience with one such agency, the National Advisory Committee for Aeronautics. This agency consists of a Committee appointed by the President, with a full-time paid administrator to carry out policies established by the Committee and to handle all the administrative affairs of the agency.

The organization contemplated by H.R. 1830 would be very similar to that of the NACA, and there is every reason to anticipate that it would function as effectively. If you fear that under H.R. 1830 the executive committee of the Foundation might attempt to concern itself with operational matters, a provision could be inserted in the bill, expressly prohibiting such activities. I do not think, however, that such a provision would be necessary. The full membership of the Foundation is required to meet only once a year, and the executive committee is required to meet only six times per year. Although either could meet more often, it seems to me that the intent of these provisions is clear, that neither body should be in continuous session. Moreover, the salary provided for the director in H.R. 1830 is adequate to secure an excellent administrator for this position. He would be expected to be in charge of all the administrative affairs of the Foundation.

There was considerable argument at the last session of Congress, to the effect that the Foundation should, at all costs, be free from political controls. These arguments are valid only in the sense that the operations of the Foundation should be free from the pressures of any special interests whatever. The Foundation is to be a government agency, and the Government is designed and established to be of the people and for the people. The Foundation should, therefore, be fully responsible to the people, and this means to the Congress of the United States. Moreover, the Foundation should not be insulated from the Executive Branch of the Government. I believe that it should be subject to the operating procedures, policies, and controls to which other agencies are subject, and which are necessary for an efficient and effective Executive Branch. It should, therefore, be subject to the controls of the Bureau of the Budget with respect to appropriations, transfers of funds, and other matters. It should also be subject to the Civil Service laws and regulations, except with respect to scientists in a very limited number of special cases.

Certain other exemptions from existing provisions of law and certain special authorizations are necessary to enable the Foundation effectively and economically to carry out its unusual functions. I have in mind such provisions as that permitting the Foundation to enter contracts without requiring performance bonds and without advertising for bids, and the provision that part-time specialists, by reason of their service with the Foundation, would not be subject to the provisions of certain criminal statutes, except with respect to matters affecting the Foundation. But these special authorities and exemptions, as they now appear, contain within themselves their own limitations, and they would not and should not place the Foundation outside any other of the usual procedures applicable to all executive agencies.

In addition to these government-wide administrative

controls and procedures, I feel that the administrative head of the Foundation should also be subject to the general control of a board of outstanding men and women with widely diversified training and experience. The Foundation will be faced with many different but exceedingly complex and highly technical questions. For example, it must annually evaluate the relative importance of scholarships, basic research, international undertakings, and publications in terms of the over-all national welfare. Within its allocation for research, the Foundation must determine the relative importance of the different fields of science. Finally, it must be able to evaluate, on the basis of their scientific merits, not only the relative importance of the various specific projects but also their potential effectiveness. Decision of these questions will require not only extensive and varied scientific knowledge but also broad and sound concepts of the Nation's best interests. In other words, the decisions must be wisely made from the standpoint of many considerations.

In the long run and in general, the Congress should, as representative of all the citizens, make decisions of policy. It is obvious, however, that the Congress lacks sufficient time to inform itself as to the various considerations involved in making these particular decisions. It must therefore delegate to others the power to make them, retaining its ultimate control through annual reports and appropriations. In my opinion, this delegation should not be to one man but should be to a group of the ablest men and women in the United States, drawn from all parts of the country, who would represent the different fields of science, education, and public affairs.

I cannot overemphasize the importance of securing the services of the ablest possible individuals to guide the Foundation. A board which is only advisory would bear responsibility for the decisions of the administrator, but would not have any real authority to control those decisions. I believe that in order to be sure to secure members of the requisite caliber, it is essential to give them authority commensurate with their responsibility.

Now, the two bills are very different in their treatment of inventions made in the course of research supported by the Foundation. H.R. 1830 directs the Foundation, in making contracts and other arrangements for research, to consider the public interest and the equities of the research organizations and individuals with which it deals. It further provides, however, that no officer or employee of the Foundation shall derive any personal benefit from inventions which may be made by him in the course of performing his assigned activities for the Foundation. This, I believe, is as far as this legislation should go in controlling the policies of the Foundation. I believe that an able director, guided by this directive and by more detailed policies which would be established by the Foundation, would protect the public interest and, at the same time, be fair to the individuals and organizations which will be performing research for the Foundation.

Now, there are three provisions in H.R. 942, the necessity of which is open to some question. I refer to Section 5, which provides for the apportionment of certain percentages of the Foundation's funds among the several states, among different types of institutions, and for different fields of research. The provisions for allocating fixed percentages of funds to nonprofit institutions and for certain named fields of research are questionable only on the grounds that they are unnecessary. I am sure that both quotas would be exceeded in practice.

The principle of wide distribution of research appropriations throughout the country seems to me basically sound. It is necessary, if our basic scientific research is to remain energetic and fruitful, that we maintain and strengthen many different research organizations throughout the country. It seems to me, however, that such wide distribution could be effectively accomplished by the Foundation under the terms of H.R. 1830. The large membership of that board, together with the stipulation that its members shall be selected so as to represent scientific opinion in all parts of the country, constitute an effective guarantee that the Foundation's funds will not be concentrated in a few large institutions or in any one section of the country. In my opinion, therefore, the policy expressed in Section 15 (h) of H.R. 1830 is quite adequate to assure that the desirable purpose of strengthening our smaller research organizations will be accomplished without imposing upon the Foundation the technical difficulties and the burden of detailed accounting which would be required by the terms of H.R. 942.

Similar considerations apply to the provisions in both bills for geographical distribution of scholarships and fellowships. I feel that scholarships and fellowships should be distributed as widely as possible, but with due regard for the ability of each applicant. Consequently, I prefer Section 9 (a) of H.R. 1830 to the corresponding provisions of H.R. 942 in that it subordinates the factor of residence to that of ability.

One or two further points of difference between the bills seem to deserve brief comment. One is the provision in each bill concerning the divisional structure of the Foundation. H.R. 942 establishes eight divisions and authorizes the administrator, with the advice of the board, to establish up to three additional divisions. H.R. 1830 establishes five divisions, but it authorizes the Foundation to abolish any of them, except for the Division of National Defense, as well as to establish new divisions. This allows greater flexibility than the arrangement of H.R. 942. Although the divisions provided in each bill cover most of the basic fields of research in

which the Foundation, as presently contemplated, is likely to engage, it is quite possible that, from time to time, it will be expedient to rearrange these divisions.

In the last session of Congress there was considerable controversy over a provision in the Kilgore-Magnuson Bill which would establish, within the Foundation, a division of social sciences. This provision was eliminated on the floor of the Senate, and I believe that was a wise move. But I do think that the controversy was unfortunate. If we, as a democratic nation of free individuals are to survive, we must seek to understand the forces which affect our social organizations in order that they may be anticipated and guided in safe directions. A large amount of research is already being devoted to various aspects of the social sciences, both by the Government and by private individuals and organizations. Much more could be done to advantage. In view of the magnitude and complexity of this field, however, it seems to me that the Foundation should carefully survey it with a view toward determining those areas which could be made the subject of fruitful research under its auspices. Under H.R. 1830 this could be done, and I hope it will be done. But it is well to make research in the social sciences permissive rather than mandatory.

Finally, I should like to say a few words about the size of the undertaking which you are considering. The Foundation, particularly at the outset, need not be a grandiose venture. In my report to the President, *Science: the endless frontier*, I suggested a budget, for the first year, of $33,500,000, including $7,000,000 for scholarships and fellowships. That budget was carefully prepared on the basis of replies to questionnaires sent to more than 300 educational and other institutions. I still think the estimate is reasonable, but two factors have intervened to make an initial appropriation of this size unnecessary. The Servicemen's Readjustment Act of 1944 will materially help to reduce the accumulated deficit of trained scientists and technicians. That does not mean that the Foundation need not commence its scholarship program immediately. It takes from four to seven years to train a scientist, as you know. However, it will lessen the urgency of the demand and permit the Foundation to plan its program carefully and begin it gradually. The Foundation will then be in a position to assume the full burden when the benefits of that act cease to be available.

The second, and greater factor, is the immediate availability of certain funds which can be transferred from the Services. The Army and Navy have shown great vision in undertaking basic research as an interim measure. Many of their research projects can, and, I am informed, will be transferred to the Foundation, supported by funds already appropriated by the Congress. These funds will materially decrease the initial appropriation necessary for the operations of the Foundation.

Of course, neither of the two bills before you is perfect, but H.R. 1830 is the best bill I have seen on the subject of science legislation. I have written to your Committee making several suggestions for changes. You will wish to make others. But those suggestions are primarily on details. What is of vital importance is that a National Science Foundation be established, and that it be established as promptly as is consistent with full examination of the matter by the Congress.

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Programs for Medicine and National Health in the USSR

Stuart Mudd, *President of the American-Soviet Medical Society* and *Professor of Bacteriology, Medical School, University of Pennsylvania*

OBSERVATION OF SOVIET RESEARCH activities was recently made possible during a visit to the USSR organized by Robert L. Leslie through the American-Soviet Medical Society and the *American Review of Soviet Medicine*. The preceding issue of *Science* described some of the work being done in experimental laboratories on problems of mental health and communal hygiene. This installment reports further on work being done by leading Soviet institutions, especially in preventive medicine and rehabilitation of war wounded.

The Prevention of Specific Infectious Diseases

The Central Institute of Epidemiology and Microbiology of the Ministry of Public Health, with grounds and buildings in the outskirts of Moscow, plans a considerable extension of its facilities over a period of 5–10 years. Diphtheria and tetanus toxin, toxoid and antitoxin, smallpox vaccine, typhus vaccine, polyvalent dysentery bacteriophage, and BCG vaccine for tuberculosis are produced here on a large scale. During the war this Institute was evacuated to the Ural mountains, where production of the needed biologicals was carried on. Production methods are standard, but less well provided with mechanical appurtenances than in this country.

Smallpox and BCG vaccine for shipment to remote parts of the USSR are dried *in vacuo* from the frozen state, and, according to Academician Michal Morosow, the results are most satisfactory. Typhus vaccine is produced by the mouse-lung method under the direction of Maria Krontovskaya. BCG vaccine is produced by growing the Calmette strain on a synthetic medium containing glycocoll, asparagine, and salts. Polyvalent dysentery vaccine contains Shiga toxoid and the five classic Flexner strains. Polyvalent dysentery bacteriophage preparations were also prepared. These were scattered during the war in soil, sewage, and food as well as being given by mouth. The director, L. Jankelevich, said that statistics regarding bacteriophage were weak; he had observed its therapeutic use, however, and thought the results were good.

Polyvalent bacteriophage as a prophylactic against the diarrheal diseases is also produced in the All Union Institute of Biological Prophylaxis of Infections, of which Z. V. Ermolieva is the director. This is a highly polyvalent preparation containing phages against *Escherichia coli, Shigella dysenteriae* (Shiga), *S. paradysenteriae* (classic Flexner types), *Salmonella paratyphi* (A and B), *Proteus*, and *Pseudomonas pyocyanea*. The polyvalent phage is given children in children's gardens and summer camps every 10 days from May to October. Prof. Ermolieva cited experiments in which groups of children had received this phage and control groups physiological salt solution, with a lower rate of incidence in the protected than in the control groups. Statistical studies are promised for the *American Review of Soviet Medicine*.

Later, in the Institute of Microbiology, Epidemiology, and Bacteriophagy of the Ministry of Health of the Georgian Republic in Tbilisi, we observed the preparation of polyvalent dysentery bacteriophage both as broth filtrate and in dry tablets. V. S. Antadze, director of research there, stated that prejudice against bacteriophage in the USSR has been overcome by controlled experiments with human populations matched as to age, weight, etc. The main point, he said, is to use many types of phage active against Shiga, Flexner, Hiss, and Sonne types of dysentery bacilli. Phage is given by mouth. For treatment, administration must begin as early as possible in the disease. In early acute dysentery, Dr. Antadze stated, there is almost immediate cure; the patient feels better in two or three days if the phage types coincide with the types of the infecting organisms. Effectiveness is very low in chronic dysentery, however.

Favorable results were also being obtained at the Institute with polyvalent bacteriophage against *Eberthella typhosa*. Cases treated in the first days of clinical symptoms were believed to be shortened to 14 or 15 days duration. Polyvalent typhoid phage was used both for prevention and treatment. It had not been successful, however, in clearing up typhoid carriers.

BCG vaccine, we were assured in the Institutes in Moscow and also in Tbilisi, where it is prepared for the Georgian Republic, is now given to every newborn child in the USSR. In Georgia, for the past two years, BCG has been administered by mouth to all newborns within the first week of life. It is also administered to populations under special risk, such as nurses in tuberculosis hospitals.

Another interesting class of anti-infective agents has been developed in the Institute of Biological Prophylaxis of Infections. According to Prof. Ermolieva, lysozyme from the horse-radish has been used since 1934 in otolaryngology and ophthalmology. Egg-white lysozyme prepared according to Bordet is used as a spray in laryngitis. According to Prof. Ermolieva, "All the best singers insist on it."

Another anti-infective called "erythrin" is extracted from erythrocytes. This is said to be bactericidal against

Corynebacterium diphtheriae, staphylococci, and streptococci. When sprayed into the nose and throat four times per day for four days in one to three courses, it is reported to clear up the chronic diphtheria carrier.

Preventive measures against rabies were touched upon by V. Ushakov, of the Institute of Experimental Medicine in Leningrad. Dr. Ushakov began work on hydrophobia in the first Pasteur Institute in Russia, organized in 1886. He joined the staff of the Institute of Experimental Medicine in 1890, where he is still working at 81 years of age.

Rehabilitation of the War Wounded

The Soviet Union has established some 300 hospitals for war veterans. Special schools for injured veterans are maintained by the Department of Public Welfare. There are some 17 institutes for special surgical rehabilitation of the war wounded and victims of industrial and other accidents. The largest of these is the Central Institute of Traumatology in Moscow. N. N. Priorov, Vice-Minister of Public Health of the USSR and director of this Central Institute, personally conducted us through this splendid hospital.

During the war special workshops were organized in the hospitals. In these an effort was made to learn the experience and training of each man and to plan his rehabilitation accordingly. At the present time special schools for injured veterans are maintained under the Ministry of Social Welfare. Invalids are divided into three groups: (1) people unable to work or to take care of themselves, (2) people unable to work but who can take care of themselves, and (3) people who can work, even though their kind of work may need to be changed. The main source of psychological disturbances is in those who do not know what work to do; when work is found for them, as a rule they become mentally sound.

Cases were described and shown to us of veterans who had lost both hands; the bones of the forearm were separated by the Krukenberg operation. These men seemed quite unself-conscious about using their arms for greeting and other purposes. Veterans who had lost both hands had entered law school and a school of economics. Those blind or without both legs were seen, as were others with spinal and facial injuries in various stages of plastic and restorative surgery. Their spirit and the relationships between staff and patients impressed us as strikingly fine. The injured veterans included women as well as men.

An interesting accessory to surgery was shown us in the case of hyaluronic acid prepared from bovine vitreous humor. This was injected intragluteally for softening scars and to facilitate healing.

Special workshops and factories are devoted to the manufacture of prosthetics. These are being revised with the aid of prosthetic devices purchased in America.

Poliomyelitis is treated in acute stages by neurologists; in late stages, by orthopedic surgeons. Transplantation of muscles is sometimes resorted to. The Kenny method is not used.

The Institute of Biological and Medical Chemistry

The 20 medical institutes visited included some of those described in the report by A. B. Hastings and M. B. Shimkin (*Science*, May 17 and 24, 1946). So manifold are the scientific activities in Moscow and Leningrad and to a less extent in other cities of the USSR, however, that our experiences only partly paralleled those of Hastings and Shimkin and included very few, indeed, of the institutions visited by Selman A. Waksman as a guest of the Academy of Sciences of the USSR (*Sci. Mon.*, April 1947) and Edward L. Young with a party from Russian Relief (*Soviet Russia Today*, 1946, **15**, 12).

A high point scientifically was the Institute of Biological and Medical Chemistry of the Academy of Medical Sciences of the USSR. This splendidly organized Institute, under the direction of J. O. Parnas, comprises five principal Divisions: (1) Intermediate Nitrogen Metabolism, (2) Protein Biochemistry, (3) Chemistry of Tissues (4) Enzymology, and (5) Biochemistry of Carbohydrates. There are also Laboratories of Physical Chemistry, Analytical Chemistry, Organic Chemistry, and Physiology, each of which has the dual function of supplying needed materials and methods to the principal biochemical divisions and pursuing its own special problems. The several subdivisions in general collaborate and supplement each other in addition to carrying on their own investigations. Each laboratory has its own responsible head. There is an institute library with an especially fine reprint collection. Scientific direction and administration, supplies, and equipment are, of course, centralized under Dr. Parnas.

The following written statement concerning the current work of the Laboratory of Intermediate Nitrogen Metabolism, headed by A. E. Braunstein, a member of the Academy of Medical Sciences, and the Laboratory of Enzymology, under M. G. Kritzmann, may be of interest:

> Braunstein and his colleagues continue the study of the enzyme system and biological significance of the enzymatic transamination of amino acids, discovered in this laboratory. A review of transamination, including a new theory of the integrative functions of dicarboxylic acids in nitrogen metabolism, by Braunstein, will appear in Vol. 3 of *Advances in protein chemistry*. The mechanism of hydrogen translocation in the course of transamination is being studied in isotopic experiments with deuterio-amino acids (Konikova and Braunstein), showing that the labilization and dissociation of α-hydrogen (hydrogen on the α-carbon) is a preliminary and independent enzymatic preliminary step of the reaction. In a cross-assay of the coenzymes of amino acid decarboxylases and transaminating enzymes, made in cooperation with Dr. Gale (Cambridge), the identity of phosphopyridoxal with the prosthetic group of glutamic aminopherase, recently an-

nounced by American authors, has been corroborated, and its non-identity with the "coenzyme" of aspartic aminopherase has been proved (Braunstein and Kritzmann).

A specific enzymatic manometric micromethod for the determination of aspartic acid has been worked out by Braunstein, Nemchinskaya, and Wilenkina. A. S. Konikova made an extensive study of the amino acid metabolism of *Bac. brevis*. An important finding of hers is that *B. brevis* contains large amounts of d-amino acids in the cell proteins as well as in gramicidin and tyrocidine.

The mechanism of the stimulatory effect of ascorbic acid on the metabolism of tyrosine has been investigated in tissue slices by R. Azarkh. The effect is positive in ascorbic acid-deficient and normal guinea pigs and in rats. It is associated with a reaction preceding deamination. Work is in progress on the mechanism of enzymatic synthesis of peptides in animal tissues.

Braunstein is preparing a comprehensive monograph on the biochemistry of amino acid metabolism for publication in Russian and English.

M. Kritzmann has proved that the Wood-Werkman reaction of CO_2-fixation and the transamination reaction are intermediary stages of the synthesis of alanine from NH_3 and pyruvate in liver slices. Phosphate is also involved in this synthesis, which has been effected, for the first time, in cell-free enzyme systems by Kritzmann and Melik-Sarkyssian. Kritzmann has succeeded in the reversible splitting of glutamic aminopherase. The nature of liver aspartic dehydrogenase is being investigated in her laboratory.

The following notes on the functional significance of adenosine triphosphate for the muscular and nervous systems were furnished by Eugene B. Babsky, head of the Physiological Laboratory:

The work of the laboratory has established the fact that small quantities of adenosine triphosphate heighten the excitability of the muscles and increase muscular contraction. Large quantities of adenosine triphosphate lower the excitability of the muscles and decrease muscular contraction. In small quantities (1×10^{-7}–5×10^{-8}) this substance stimulates tetanic contractions.

The laboratory's experimental data lead us to the conclusion that the release of adenosine triphosphate which occurs with every individual muscular contraction heightens the excitability of the muscles (researches of E. B. Babsky and F. D. Sheikhon).

The laboratory's investigations have also shown that adenosine triphosphate sensitizes muscles to acetylcholine and choline. The interaction of these substances is of importance in the transmission of an impulse from the nerve to the muscle, since when the nervous impulse reaches the muscle acetylcholine is released in the neuro-muscular synapse, and adenosine triphosphate in the muscle.

The substance described by numerous investigators as contained in the tissues of the brain and as acting as a sensitizer to acetylcholine is, according to the data obtained in this laboratory, adenosine triphosphate (researches of E. B. Babsky and P. F. Minayev).

In investigating the influence of adenosine triphosphate taken from the muscles or from the brain, upon electroencephalograms, it has been shown that this substance markedly affects the amplitude and frequency of cerebral potentials. This is a direct indication of the physiologic significance of adenosine triphosphate in the functions of the brain (researches of E. B. Babsky, A. E. Gurvich, and M. N. Livanov).

A third program of special interest was described by S. O. Kaplainsky, head of the Laboratory of Chemistry of Tissues. Studies in this laboratory are concerned with the effects of protein deprivation and wound dystrophy. These have shown that in conditions of extreme deprivation of protein essential enzymes of the tissues may become deficient. The proteins of the deamidizing and decarboxylating systems are thus partially lost. In consequence, nonoxidized keto-acids and nondecarboxylated amino acids are eliminated in the urine. The excretion of amino acids in the urine may be increased three to four times in wound dystrophy. There is decrease in urea excretion due to lack of function of an enzyme in the liver; enzymes in the kidney are less impaired. Changes in the enzyme systems of the brain are also involved; respiration of brain tissue may be decreased two- to threefold. Metabolic detoxification processes may be stopped almost entirely.

The consequences of loss of the proteins of the fermentative systems resemble in some features the avitaminoses due to lack of enzymes for which the deficient vitamins are coenzymes. Some of the observed changes in man seem to be irreversible, even after restoration of normal protein intake, if protein deprivation has been too long continued. The best restorative measures, in the experience of these investigators, are intravenous administration of fresh human plasma and the feeding of liver proteins.

The State Central Medical Library

The State Central Medical Library of the Ministry of Health of the USSR, of which L. Bassias is the director, must be mentioned because of its importance as an agency for exchange of literature in the medical sciences between the United States and the USSR. The staff comprises some 140 persons, 138 of whom are women.

Here we found a fine collection of foreign journals, including the best English and American psychiatric and mental hygiene journals, as well as the *Journal of Bacteriology*, *Journal of Immunology*, *Journal of Biological Chemistry*, etc. We were informed that the *Journal of Biological Chemistry* was the most used journal in English. Many books in English were on display, and a whole room was devoted to catalogues of American medical and scientific supply firms. We were told that money to buy books (in English) was now in hand and that their immediate need was for catalogues. Everywhere in stacks and reading rooms there was evidence of intensive use of the facilities available. Both Dr. Bassias and her assistant librarian, Mrs. Maisil, showed great enthusiasm for, and devotion to, their work. They in turn spoke of the heroic girls who had worked in the dark and cold of

the library every day during the war, even though a bomb fell through the stacks. In a recent letter to Mrs. Mudd, Dr. Bassias writes:

> We have only just summed up the results of our work for the three quarters of the first postwar year which appear to have surpassed our expectations. They showed that we have outdistanced the achievements of the last prewar year. In 1940, our reading rooms have been visited 60,476 times and 237,884 books have been borrowed from the stacks, while throughout the period from January 1st to October 10th, 1946, 68,371 visits to the reading rooms and 235,914 loans from stacks were already registered. The same increase can be seen in all the branches of our work and not only in our Library but also in other medical libraries of our country.
>
> These figures reflect as in a mirror the intensive, creative work of our medical workers, who strive, as well as all the other people here, to cure as soon as possible the wounds inflicted by war. Nobody in our country derives profit of war. On the contrary, war brings only suffering to all the people and demands heavy sacrifices. It would be so nice if all could understand, as you do, how much happiness we gain from our peaceful work, the results of which we feel so vividly. Work really has become in our country a "matter of honour, valour and heroism," and I suppose this to be the main characteristic feature of Soviet people.

The Five-Year Plan of the Academy of Medical Sciences

A comprehensive five-year plan of medical research and its applications was adopted in preliminary form by the Academy of Medical Sciences of the USSR early in September 1946 and was formally adopted in November. This plan, covering 200 mimeographed pages, will appear, when translated, in the *American Review of Soviet Medicine*. The areas of research covered are thus listed in the Table of Contents:

I. Main Problems of Public Health in the Postwar Period: Scientific principles of Soviet public health protection; Medicosanitary consequences of the war and measures for overcoming them; hygienic standards and sanitation of external environment; protection of the health of mother and infant; child health protection; protection of the health of industrial workers; problems of nutrition.

II. Medical Problems Arising From War Traumas: Restoration of functions after war traumas; clinical and pathophysiologic study of traumas of the nervous system and their restorative therapy; biology of infected wounds; traumatic shock; the problems of pain.

III. Problems of Infection in Theory and Practice: Infection and immunity; epidemiology and pathology of infection; malaria, helminthiasis and other problems of medical parasitology; ultraviruses and ultravirus diseases; tuberculosis; problems of scarlatina in child health protection; the problem of sepsis; etiotropic therapy of infectious diseases.

IV. Urgent Problems of Clinical Medicine: The problem of malignant growths; hypertonia; gastric and intestinal ulcers; problems of modern hematology and blood transfusion.

V. Physiologic Regulation and Means of Actively Influencing It: Reactivity of the organism; correlative processes in the organism; regulation of the composition and properties of the internal medium of the organism; pharmacological regulation of functions; the influence of physical factors on the human organism; capacity for work, fatigue and rest.

VI. Physiology and Pathology of Nervous Activity: Factors of integration in the nervous system; the higher nervous activity; psychoses (pathogenesis and therapy).

VII. Certain Problems of Theoretical Medicine: General physiology and pathology of the cell; growth and development of the normal and pathological organism; metabolism and energy; the physiology of digestion; history of medicine.

The secretary of the Academy states that the proposals incorporated in this plan originated with the staffs of the 25 component institutes of the Academy. They were then subject to discussion between the presidium of the Academy and the component institutes. The plan, as finally agreed upon, was adopted by the Academy and returned to the institutes as a recommended but not obligatory program. The emphasis of the plan on fundamental theoretical problems is noteworthy.

Academician A. I. Abrikosov, first vice-president of the Academy of Medical Sciences, in comment upon this five-year plan, has written in part:

> It is to be pointed out that the five-year plan of the USSR Academy of Medical Sciences insures the genuinely scientific synthesis of the various scattered factual findings obtained by scientists, institutes and laboratories in the course of their work on one or another phenomenon. . . .
>
> The essence of our method does not consist in mere registration of phenomena. The task of the Soviet scientist is to explain phenomena and their causal interdependence, to combine theory with practice in relation to man not only as a biological unit but as a social being whose normal and pathological development is affected first and foremost by the social conditions prevailing in his environment (*Moscow News*, November 16, 1946).

Interchange of scientific literature between the United States and the USSR is already established and is growing; the science of both countries is enriched thereby. The sending of reprints, monographs, foundation reports, and book catalogues relating to the medical sciences is one easy and concrete way of promoting intercultural understanding. These may advantageously be mailed to the State Central Medical Library of the Ministry of Health, Sadovo-Kudrinskaja, 1, Moscow, USSR. Good will exists between those scientists of the two countries who have had the opportunity for personal acquaintance. It is the author's earnest belief that the good of both countries demands the future broadening of the basis of mutual understanding and good will.

NEWS *and Notes*

The Executive Committee of the newly-formed Inter-Society Committee for a National Science Foundation has circulated a questionnaire to the delegates of the 70-odd societies which have combined to urge that a National Science Foundation be established in this Congress. The questionnaire is designed to get a vote on the controversial issues, asking specifically about the type of administration preferred, the patent provisions, the inclusion of the social sciences, and the extension of scholarships and fellowships into the undergraduate years. Returns have been received from about 70 per cent of the members. Two-thirds prefer a single administrator as called for in S 525; 20 per cent favor the board type of administration described in S 526; the others prefer a commission form of administration. Practically everyone is willing to accept the S 526 patent provision. Two members voted to exclude the social sciences, and 40 per cent would be willing to accept a Foundation which did exclude them. The final tabulation will become part of the report which will be presented to the Committee on Interstate and Foreign Commerce, now considering the bill in the House, as an extension of the testimony offered on March 6 by Edmund E. Day, president of the Inter-Society Committee.

About People

Arthur E. Meyer, formerly director of research, Maltine Foundation of Therapeutic Research, is now director of the Research Division, Fellows Pharmaceuticals, 26 Christopher Street, New York City.

Theodore H. Eaton, Jr., has been appointed professor of biology at Southwestern College, Winfield, Kansas.

James L. Gamble, professor of pediatrics, Harvard Medical School, delivered the 6th Harvey Lecture of the current series at the New York Academy of Medicine, March 20. He discussed "Physiological Information Gained From Study on the Life Raft Ration."

Willis Robert Boss has been appointed associate professor of zoology at Syracuse University, Syracuse, New York, to begin September 1, 1947. Dr. Boss was formerly at the State University of Iowa and since February has been at State Teachers College, Edinboro, Pennsylvania.

Keith B. McCall, who has just completed work toward the Doctor's degree at the University of Wisconsin, is now instructor in biochemistry at Michigan State College, East Lansing.

Harold F. Blum, who served during the war as principal biophysicist at the Naval Medical Research Institute and spent the past year as a Guggenheim Fellow, has rejoined the staff of the National Cancer Institute to work at the Marine Biological Laboratory, Woods Hole, Massachusetts.

Freeman D. Miller has been appointed associate professor of astronomy and Max Hutt, associate professor of psychology, at the University of Michigan, Ann Harbor, to begin in the fall of 1947.

Hobart E. Stocking, Department of Geology, Oklahoma A. and M. College, has been awarded the title Professor Honorario of the Faculty of Sciences, University of Costa Rica, by Rubén Torres R., dean of the Faculty. Prof. Stocking served as State Department visiting professor at the University during 1945.

B. O. Dodge, plant pathologist, retired from the staff of New York Botanical Garden, December 31. The *Bulletin* of the Torrey Botanical Club is dedicating Volume 74 to him. Dr. Dodge's principal work has been with *Neurospora*, which he holds to be capable of mutating and hybridizing.

Harry Seneca, with the Army until a few months ago and formerly at Tulane University, is now associated with the Clinical Research Division of the Schering Corporation, 120 East 30th Street, New York City.

George K. Bennett, vice-president of The Psychological Corporation, was recently elected president to succeed Paul S. Achilles, who has become vice-chairman of the board of directors. Dr. Bennett joined the Corporation in 1936 as director of the Test Division, and from 1942 to 1945, in addition to his other duties, was in charge of war research. Dr. Achilles has been with the Corporation since 1929 and president since 1944.

Harvey Lincoln Curtis, physicist at the National Bureau of Standards since 1907 and for 32 years chief of the Inductance Capacitance Section, has retired, according to E. U. Condon, director of the Bureau. He is past-president of both the Philosophical Society of Washington and the Washington Academy of Science.

Eric Thomas Stiller, formerly head of the Department of Organic Chemistry, Wyeth Institute of Applied Biochemistry, has been appointed a member of The Squibb Institute for Medical Research, New Brunswick, New Jersey, in charge of the newly-formed Division of Chemical Development.

Atherton M. Whaley has recently been made president of Halogen Chemicals Incorporated, manufacturers of organic halides, Columbia, South Carolina.

John F. Enders, associate professor of bacteriology and immunology, Harvard Medical School, has been appointed director of the Research Department of Infectious Disease of the newly-organized Children's Medical Center, with laboratories at Children's Hospital, Boston, Massachusetts.

Theodor von Brand, formerly professor of biology, Catholic University of America, is now chief of the subsection on physiology, Zoology Laboratory, National Institute of Health.

Colleges and Universities

The Stanford University School of Medicine, San Francisco, California, announces the 65th course of popular medical lectures to be delivered during March and April at Lane Hall, San Francisco. "New Eyes for Old: Corneal Transplants" was discussed by Max Fine March 7; "The War on Cancer," by David A. Wood, L. Henry Garland, and Leonard G. Dobson, is scheduled for March 21; "Delinquency and Mental Health in a Changing World," by Hale F. Shirley, April 11; and "Contagion From Foreign Lands," by Rodney R.

Beard, April 25. The lectures, which are illustrated, are open to the public.

Rockford College, Rockford, Illinois, presented the following scientists at a conference on science, held as part of its centennial celebration February 21-23: Enrico Fermi, professor of physics, University of Chicago, who delivered the Charter Day address; Wendell M. Stanley, Rockefeller Institute for Medical Research; Frank B. Jewett, National Academy of Sciences; Detlev W. Bronk, chairman, National Research Council; Roger Adams, head, Chemistry Department, University of Illinois; Lillian Gilbreth, professor of management, Purdue University; John Torrence Tate, professor of physics, University of Minnesota; Emma Perry Carr, emeritus professor of chemistry, Mount Holyoke College; and Ruth M. Addoms, associate professor of botany, Duke University.

Rockford College was chartered February 25, 1847.

Meetings

A Symposium on Molecular Structure and Spectroscopy will be held at the Mendenhall Laboratory of Physics, The Ohio State University, June 9–14. There will be discussions of the interpretation of molecular spectroscopic data, as well as methods for obtaining such data, and sessions devoted to microwave and Raman spectroscopy. Dormitory rooms will be available. Further information may be obtained from Harald H. Nielsen, Mendenhall Laboratory of Physics, The Ohio State University, Columbus 10, Ohio.

The Midwestern Psychological Association will hold its 19th annual meeting at the Edgewater Beach Hotel, Chicago, May 2–3. Programs will be mailed to members about April 10. The Chicago Psychological Club is sponsor of the meeting, with Edvin Brye, Chicago Teachers College, chairman of the arrangements committee.

Reorganization of the American Institute of Physics and plans for a new semipopular monthly journal have been announced by the Institute.

Effective immediately, the 7,000 members of the five societies—American Physical Society, Optical Society of America, Inc., Acoustical Society of America, Inc., American Association of Physics Teachers, and Society of Rheology—will become members of the Institute, whereas before the Institute had no individual memberships. Provision is also made for associate membership in the Institute, open to others interested in physics.

No change is made in the organization, functions, and activities of the five societies, the announcement, published in *The Review of Scientific Instruments*, said.

Although there will be a new journal, technical journals now published by the Institute and member societies will remain unchanged. The new journal is designed "to foster unity among physicists and their societies, as well as understanding of the contribution and implications of physics."

Lowell Observatory, Flagstaff, Arizona, recently received a gift of the optical parts of a large Schmidt telescope from Roger Lowell Putnam, trustee of the Observatory since 1927. The correction plate of the telescope has a clear aperture of 25 inches and the aperture-to-focus ratio is one to four, the observatory disclosed.

Jose C. Mendiola, director of the laboratory, National Psychopathic Hospital, Mandaluyong, Rizal, Philippine Islands, has written that his workers are in need of recent publications on histopathological technique.

NRC News

A Committee on International Scientific Unions has recently been appointed by the NRC. Keeping itself informed on matters relating to unions and ready to advise and assist American scientists and scientific organizations in their relations to these international bodies, the Committee consists of John A. Fleming, president, International Council of Scientific Unions, chairman; and L. V. Berkner, Marston T. Bogert, Karl K. Darrow, J. H. Dellinger, Joel Stebbins, Marshall H. Stone, Alexander Wetmore, and John K. Wright.

Recent Deaths

Charles L. Stevenson, 80, former professor of chemistry at McGill University, Montreal, and research chemist at the Wilmington plant of E. I. du Pont de Nemours & Company, died in West Long Branch, New Jersey, March 5.

Philip W. Schutz, 38, professor of chemical engineering, University of California, Berkeley, died in Oakland March 7. He was consultant to the Manhattan Engineering District during the war and went to Berkeley to direct the University of California's program in chemical engineering last September.

Sir Halford John Mackinder, 86, English geographer, and holder of the Charles P. Daly Medal of the American Geographical Society of New York, died March 6 in London. One-time professor at the University of London, Sir Halford was also a member of Parliament for 12 years.

Henry M. Pease, 71, first vice-chairman and a director of the International Standard Electric Corporation, and vice-president and director of International Telephone and Telegraph Corporation, died in New York March 6.

Noboru Takahashi, 54, plant breeder on experiment stations in Korea for 21 years under the Japanese, died July 7 in Japan. After graduating from Tokyo Imperial University, he conducted experiments in field crops, particularly rice and soybeans, in Korea from 1919 to 1945, except for years when he took graduate work in the U. S. and Germany. He has contributed generously of plant material to the U. S. Department of Agriculture, according to USDA officials.

Make Plans for—

Midwest Power Conference, March 31–April 2, Palmer House, Chicago.

American Association of Anatomists, annual meeting, April 3–5, Mount Royal Hotel, Montreal, Canada.

The Electrochemical Society, Inc., annual congress, April 9–12, Louisville, Kentucky.

American Chemical Society, spring meeting, April 14–18, Atlantic City, New Jersey.

Institute of Mathematical Statistics, meeting on stochastic processes and noise, April 24–25, New York City.

National Academy of Sciences, annual meeting, April 28–30, Academy Building, Washington, D. C.

TECHNICAL PAPERS

Antiseptic Action of Glycerite of Hydrogen Peroxide on *Mycobacterium tuberculosis* (var. *hominis*)

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In a previous communication, the bactericidal effects of glycerite of hydrogen peroxide on gram-positive and gram-negative bacteria, as measured by the cup-plate technique, were described (*1*). A second report, concerned with oral organisms, demonstrated the solution as extremely bactericidal by both *in vitro* and *in vivo* studies (*4*). The present paper describes the effects of the solution on *Myco. tuberculosis* (var. *hominis*) as measured by laboratory methods, and clinically on patients with tuberculous lesions of the body surface.

The solution consists of hydrogen peroxide (1.5 per cent) as derived from urea peroxide (4 per cent) dissolved in anhydrous glycerol. Although such solutions are relatively stable (*1*), a secondary stabilizing agent, 8-hydroxyquinoline, is present in concentrations of 0.1 per cent.

To obtain a uniform suspension of cells, the organism is grown in Long's broth medium in 22-ml. tubes for 5 days at 37° C. The cultures are placed on a Kahn shaker for 30 minutes and the clumps permitted to settle. The upper portion of the liquid, containing the suspended bacteria, is pipetted into sterile tubes. The organisms from several tubes (usually two or three) are pooled. Of this suspension, 0.5 ml. is inoculated into tubes containing 20 ml. of liquefied, cooled, Long's agar medium. After thorough mixing, the agar is poured into a Petri dish and permitted to solidify. The bacterial content of each plate averages 9,000,000 organisms as determined by plating 1:10,000 and 1:100,000 dilutions of the bacterial suspension in Long's agar.

Penicylinders (porcelain) are placed centrally on the agar and into each is pipetted 0.1 ml. of the solutions to be tested. These consist of glycerite of hydrogen peroxide, in serial dilutions of 0.1, 0.5, 1, 2, and 4 per cent (given as total urea peroxide); phenol, 2, 3, 4, and 5 per cent; penicillin, 10, 50, 100, and 1,000 units; sulfaguanidine, 1 per cent; sulfadiazine, 5 per cent; and sulfamethazine, 10 per cent.

The plates are incubated at 37° C. for 3 days. The zones of inhibition are measured in millimeters from the edge of the cup to the edge of the clear zone. Evidence of either bacteriostasis or bactericidal potency is determined by transfer of pea-sized portions taken from the center to the periphery of the clear zone to slants of Long's agar and to tubes of Long's broth. These are incubated for 14 days at 37° C.

As was expected, penicillin exhibited no measurable effects. Partial inhibition for the entire plate, with apparent clear zones, resulted from exposure to phenol. There was partial inhibition, with no clear zones, when the sulfonamides were used. For all of these solutions, however, the action was one of bacteriostasis, since all samples of transferred agar, by subculture technique demonstrated viable organisms.

For the glycerite of hydrogen peroxide in the 0.5, 1, 2, and 4 per cent concentrations there were clear zones containing no viable organisms; that is, there was bactericidal action. For the 0.1 per cent solution there was a clear zone with bacteriostasis. The average radial measurements were, successively, 13, 17, 20, and 24 mm., repetition demonstrating statistically acceptable equivalent results.

In a separate set of experiments (*3*), a 17-day-old culture of *Myco. tuberculosis*, as grown on Petragnani's medium, was used. Ten-mm. cubes of this medium are cut and immersed in glycerite of 8 per cent hydrogen peroxide (total urea peroxide) for periods of 1, 2, and 24 hours. The cubes containing the bacteria are removed from the antiseptic solution at the end of the specified time, and, in order to counteract the residual peroxide solution, are placed in Brewer's thioglycolate medium for 1 hour. The cubes are then mixed with sterile saline and streaked on Petragnani's medium. A growth-control cube is placed into the thioglycolate medium and the saline and streaked on the same medium.

Following immersion for 1 hour, the cubes demonstrated slight growth visible by the 9th day of subculture. Following immersion for 2 or 24 hours, there was no growth for periods up to 21 days. The growth control showed a moderate growth by the 9th day.

From this it may tentatively be concluded that the solution is probably bactericidal for *Myco. tuberculosis* in periods of about 2 hours and with certainty in periods of more than 1 but less than 24 hours.

Since other substances will act *in vitro* on *Myco. tuberculosis* but are ineffective *in vivo*, clinical experiments were performed with four patients studied by Dr. Joseph Goldberg, of the Essex County Tuberculosis Sanatorium, Danvers, Massachusetts. All demonstrated "cold abscesses," which were positive by smear and culture for *Myco. tuberculosis*. In one patient the sites were multiple, involving the chest, thigh, buttock, and leg. In the remaining three, the chest wall alone was affected. None had responded to previous treatment, and as is generally known, this condition does not heal spontaneously, and no local measures have so far been effective.

The glycerite of hydrogen peroxide (urea peroxide 4 per cent) was applied as a wet dressing 2–6 times daily. No other treatment was used. All previous treatment is noted as having been without effect. In three patients, the abscesses healed completely; and in the last, who presented multiple lesions and who is still under treatment, the fourth lesion, although greatly diminished in size and obviously healing, shows occasional slight serous discharge. In no patient was there

vidence of irritation or allergic reaction for a treatment eriod which varied from 4 to 11 months. In order to make ertain that these were not temporary remissions, one year was ermitted to elapse before the clinical report was made, the irst patient having healed by February 1945 and the last by November 1945.

It is hoped that this preliminary communication will stimuate further exploration of the treatment of tuberculous lesions ith glycerol peroxide solutions.

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Depletion of Vitamin A Reserves in the Livers of Cattle

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In a recent publication (*2*) the writers reported on the depletion of vitamin A reserves in the livers of steers while in the feed lot. One-hundred twenty Hereford steers, about 18 months of age, were taken from native grass pasture and placed on a fattening ration consistent with good feeding practice. Table 1 gives the slaughtering data and the average vitamin A content of the livers. Vitamin A was determined by the method of Davies (*1*).

TABLE 1

Days in the feed lot	No. of animals slaughtered	Vitamin A reserves (μg. vitamin A/gram liver)
0	22	51.4
41	19	23.7
76	20	11.9
119	19	5.3
166	40	1.9

A relationship in the above data has recently been pointed out by Norris Embree, of Distillation Products, Inc. It was mentioned (*2*) that the curve obtained by plotting the data in Table 1 shows a decreasing rate of loss of vitamin A reserves throughout the experimental period. Dr. Embree cited an article by K. C. D. Hickman (*3*), also of Distillation Products, Inc., which appeared while the above publication was in press and in which Dr. Hickman proposed the hypothesis that the rate of depletion of the body reserves of a vitamin are directly proportional to the total reserves of that particular vitamin in the body. Further, when an animal is subjected to vitamin therapy, it should be possible to calculate a period of half adjustment.

To determine the validity of Dr. Hickman's hypothesis, the data in Table 1 were subjected to analysis. Vitamin A reserves were plotted against days in the feed lot and vitamin A values determined at intervals of 40 days. Table 2 gives the values obtained.

TABLE 2

Days in the feed lot	Vitamin A reserves (μg. vitamin A/gram liver)	Drop in 40 days (%)
0	51.4	—
40	24.2	47
80	11.1	46
120	5.2	47
160	2.2	42

It will be observed that the percentage drop in vitamin A reserve in the liver at the end of each 40-day period is practically constant. This supports Dr. Hickman's hypothesis as regards the rate of depletion of body reserves of a vitamin.

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Thromboplastic Properties of Penicillin and Streptomycin

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Moldavsky, Hasselbrook, and Cateno (*6*) have described some interesting findings with the blood of patients receiving parenteral injections of penicillin. In a series of human subjects studies on the clotting of blood before and after administration of penicillin revealed that the clotting time was much shorter after injections of the antibiotic than the normal clotting time was before injection. In connection with a study of blood in hemophilia the present writer and Dr. Marcus Ostro repeated the above observations on normal clinical subjects and confirmed the findings made by Moldavsky and his associates, but, curiously enough, when injections of penicillin were given to two patients suffering from hemophilia, no shortening of coagulation time was produced by the drug (*5*).

Inasmuch as it has been discovered experimentally on animals and confirmed by clinical observations that drugs belonging to the digitaloid group show a definite tendency to promote coagulation of blood (*2*, *3*), and inasmuch as more recently certain widely employed mercurial diuretics have also been found to produce such a thromboplastic effect leading occasionally to fatal thrombotic accidents (*4*), an extensive investigation was undertaken to ascertain the frequency and degree of the thromboplastic effects of penicillin on the blood of higher animals. For this purpose not only the ordinary

[1] Grateful acknowledgment is made to the Commercial Solvents Corporation and its medical director, Dr. Lawrence Smith, for valuable aid in carrying out this research.

amorphous penicillin available on the market but also the more recent crystalline sodium salts of penicillin were examined, and, still further, the isolated crystalline penicillin principles as well as the newer antibiotic streptomycin were tested.

Method

Over 200 experiments on blood coagulation were performed. These studies were confined to the clotting of *whole blood* as studied by the original Howell Method or, as it is sometimes known, the Lee and White Method. One cc. of whole blood is drawn and immediately put into a homeopathic vial 1 cm. in diameter, and the clotting time is measured with a stop watch, the end-point being taken when the vial can be inverted without flowing of the blood. The majority of the experiments were made on rabbits and cats; a few were also made with dogs' blood and still others with human patients' blood. In obtaining blood from lower animals, as in the case of rabbits, the samples were drawn by heart puncture. In the case of cats, nembutal anesthesia was first produced and blood drawn either directly from the heart or from the carotid arteries. In making these coagulation studies a good deal of experience is required to avoid complications such as admixture of tissue juices, etc., which may produce abnormal changes in coagulation time.

The earlier studies, begun in the summer of 1945, were made with sodium salts of amorphous penicillin, a dozen or more brands of such penicillin on the market being used. Later, with the development of more reliable therapeutic products, the colorless and more stable crystalline sodium salts of penicillin were employed and compared with the amorphous variety. In these studies the crystalline sodium penicillin of the Commercial Solvents Corporation was used for the most part. Later, through the courtesy of the same concern and also partly by courtesy of Dr. Harry Eagle, of the Johns Hopkins School of Hygiene and Public Health, small quantities of the four crystalline active principles of penicillin were studied separately and in combination with each other. The streptomycin employed in this present work was obtained through the courtesy of Dr. C. S. Keefer, of the Evans Memorial Hospital, Boston.

Results

Amorphous penicillin of every brand examined produced marked acceleration of clotting time, whether injected intravenously or intramuscularly and even when administered by stomach tube mixed with amphogel. The onset of this property can be noted usually within 15 or 20 minutes after injection but in some cases is most marked about one hour after. The effect persists usually for several hours.

When the newly produced sodium salt of crystalline penicillin (C.S.C.) was examined, however, the thromboplastic effect was much less striking. According to the scientists in charge of preparing the crystalline substances, this preparation consists almost entirely of penicillin G. For this reason it was deemed very desirable to secure and examine the comparative effects on coagulation of the four crystalline penicillin principles. Penicillin G (benzyl penicillin) and penicillin F (pentyl penicillin) were much less thromboplastic in their efficiency than penicillins X (hydroxy benzyl penicillin) and K (heptyl penicillin). The most potent in this respect was X. Next in order came K, followed by G and F. It was found, furthermore, that a small dose of penicillin X added to penicillin G produced a synergistic effect and hastened coagulation much more than a large dose of G alone.

Streptomycin was found to be also markedly thromboplastic for blood of rabbits and cats.

Discussion

In the light of these experiments and the results outlined above, there can be no doubt as to the accuracy and importance of the observations first reported by Moldavsky and his associates.

The author was also impressed by the interesting fact that when rabbits were repeatedly used for the above experiments, the coagulation time of those animals was permanently shortened for long periods of time, so that for examination of new preparations fresh animals had to be employed. It was also interesting to learn that this shortening in coagulation time in rabbits and cats could be antagonized and canceled by suitable doses of dicoumarol administered by stomach. It is the opinion of the present writer that, next to the chemotherapeutic properties of penicillin and streptomycin and their low toxicity, the most important pharmacological finding is their thromboplastic activity, which at first impresses the clinician as a very dangerous factor to be considered in their therapeutic use. Fortunately, however, nature has provided such generous checks and balances as well as compensatory and reserve faculties to the higher animals that thrombotic accidents in medical practice after the use of penicillin are extremely rare. Nevertheless, such clinical reports are already cropping up, as, for instance, that by G. Frada (*1*), who reports four patients with embolic accidents attributed by him to increased coagulability of the blood due to penicillin. The complete details of the present research will appear in the *Archives Internationales de Pharmacodynamic et de Therapie.*

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Activity of Protein Synthesis by the Intestine

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In a recent paper (*1*) Bloch reported that the proteins of the intestinal wall of an animal fed arginine labeled with N^{15} had the highest isotope concentration. He advanced two alternate explanations to account for his finding: (1) If the bulk of the absorbed amino acids is carried by the portal vein, arginine enters the internal organs only after passage through the liver, where arginase and the ornithine cycle cause the replacement of the isotopic amidine nitrogen by ordinary nitrogen; thus, the proteins in the liver and those poured out by the liver have a low isotope concentration if compared to the

teins of the intestinal wall. Or (2) the amino acids are ized while they are being absorbed, and thus the arginine uld be incorporated into the protein of the intestinal wall thout having been exposed to dilution.

Bloch's first explanation cannot account for the observation t orally administered methionine (labeled with S^{35}) shows highest incorporation in the proteins of the intestinal cosa, as reported by Tarver and Schmidt (*2*). Bloch's ond explanation was tested in our laboratory by injecting eled methionine *by way of the jugular vein*. (Bloch admin- red the amino acid orally.) Again the protein of the intes- l mucosa showed the highest isotope concentration. The e result is obtained when tyrosine (labeled with C^{14}) is jected intravenously.

The interesting finding that the intestinal mucosa has the hest specific activity is explained by us as being due to ual increased protein synthesis rather than to the conditions the experiment. The intestinal wall secretes enzymes and ucous-proteins which are lost in enormous quantities (unlike her enzymes and proteins within the body). To compensate this loss the intestinal wall may be more active in protein nthesis than other organs.

If this explanation is correct, then the pancreas should also ow a high turnover rate; pancreatic juice contributes many zymes needed for digestion. Actually Tarver and Schmidt) found that the pancreas has the second highest specific tivity among the organs of animals treated with isotopic ethionine.

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Lipoid Substance in the Cells of Proximal Convoluted Tubules of the Kidneys of Young Rats on a Choline-deficient Diet

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Descriptions of the histological changes in the acute "hemorrhagic" kidney of young choline-deficient rats make little, if any, mention of the appearance in frozen sections of any demonstrable fat (*1*). In a series of such sections stained with Sudan IV, from kidneys of rats three to four weeks of age and weighing 35–45 grams, fatty droplets have been consistently observed in the cells of the proximal convoluted tubules. The animals were killed at daily intervals after being placed on a choline-deficient diet. These fatty changes were usually first seen on the third day, but in one instance were observed as early as the second day. The droplets of fat increased in size and number, reaching a maximum on the sixth or seventh day, when congestion, hemorrhage, and cortical necrosis were readily demonstrable.

The appearance of this fat may be secondary to degenerative changes in the tubular epithelium resulting from dietary lack of the lipotropic factor, choline; but the possibility that it may be important in the production of the other lesions of the "hemorrhagic" kidney is being investigated. The fatty droplets are observed before the onset of congestion, necrosis, hemorrhage, or cast formation. It has already been demonstrated (*3*) that the lipase content of the proximal convoluted tubule is diminished or absent in such kidneys. Reduction of the ratio of the phospholipid fraction to the total lipid content has also been established (*2*). Further biochemical and histochemical investigations of the nature of the histologically demonstrable fat are being undertaken to determine its relationship, if any, to the kidney lesions which result from choline deficiency.

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Quick Decline of Orange Trees—A Virus Disease

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Recent results of experimental tests set up in southern California in June 1945 have shown that the highly destructive quick-decline disease of oranges is infectious, and these new results, now viewed in connection with other experiments, indicate that it is a virus disease. Quick decline, known only since 1939, is similar in many respects to the disease known in Brazil as *tristeza*, which, within the last 8 or 9 years, is reported to have almost completely destroyed all orange trees on sour orange root stocks in Argentina and Brazil. The quick-decline disease has been known to occur only on sweet orange varieties on sour orange root stock. Consequently, a test was made with 200 one-year-old healthy Valencia orange trees grown on sour orange stock. Live buds from quick-decline trees were placed in 100 of these healthy trees, and 100 trees were used as checks. Healthy buds were placed in 50 of the latter group, and 50 remained unbudded.

In September 1946 a few trees into which diseased buds had been inserted began to show symptoms. On November 11, 1946, 36 per cent of the trees in which diseased buds had been inserted showed symptoms; only 2 per cent showed disease in each of the two groups of the check trees. Since all these test trees were healthy trees that had originated in a non-diseased area and were planted in a quick-decline area in the open, the 2 per cent was presumably caused by natural infection.

A description of the transmission tests and of many other experiments planned for investigation of other phases of the quick-decline problem will be found in the April, October, and December 1946 numbers of *California Citrograph*. The more detailed evidence on which this preliminary statement is made will appear later.

The great preponderance of diseased trees in the inoculated

group as compared with the checks, together with much additional data which indicate that the disease is not due primarily to organisms, nutritional unbalance, or other factors, lead to the definite conclusion that it is of the nature of a virus disease.

A Quantitative Study of the Complement-Hemolysin Relation

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A precise spectrophotometric method employing the end-point of 50 per cent hemolysis (*2*) has been used to measure the changes in complement activity that occur when a standard suspension of sheep's erythrocytes is sensitized with graded amounts of a hemolytic antiserum. Complement was titrated without preliminary incubation, and the 50 per cent units were determined by the method of least squares. The latter were then plotted against the corresponding amounts of antiserum to give the curve of the complement-hemolysin relation (*5*). Analysis of the experimental findings indicated that this curve may be rectified by plotting the ratio x/y, as ordinate, against x, as abscissa, where x represents hemolytic antiserum, and y, the unit of complement. A graph of the results obtained in a

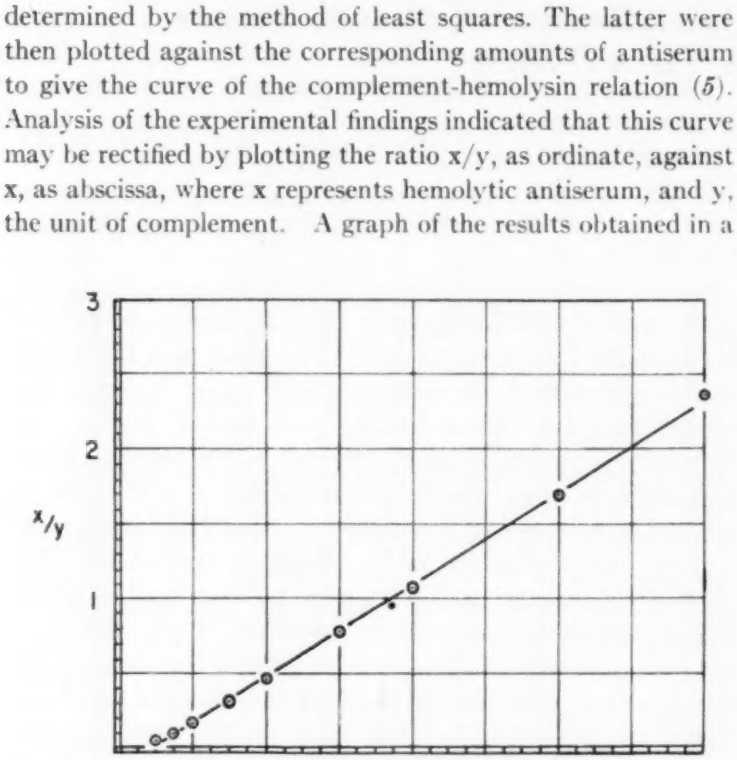

FIG. 1. Graph of x/y vs. x, where x represents hemolytic antiserum; y, the 50 per cent unit of complement.

representative experience is shown in Fig. 1. In fitting the line

$$(x/y) = bx + a \qquad (1)$$

to such data, the method of least squares was used to find values of b, the slope, and a, the intercept on the ordinate axis. For the example given, it was found that b = 0.308 and a = −0.137. To test the applicability of Equation 1 to the experimental points, the ratios x/y were calculated by substituting the predetermined values of a and b in the equation and allowing x to take on those used experimentally. The standard deviation of the observed from the calculated ratios was estimated (*3*) from

$$s'^2 = \Sigma\,[(x/y)_{observed} - (x/y)_{calculated}]^2_{N-2}. \qquad (2)$$

The estimate, $s' \leqq 0.022$, was obtained for the results plotted in Fig. 1.

Solving Equation 1 for y gives

$$y = \frac{x}{bx + a}, \qquad (3)$$

which would express the curve of the complement-hemolysin relation. Vertical and horizontal asymptotes of this curve are demonstrable (*1a*), respectively, at

$$x = \frac{-a}{b} \text{ and } y = \frac{1}{b}.$$

If the axes are translated to a new origin at the point $(\frac{-a}{b}, \frac{1}{b})$ the equation assumes the standard form for a rectangular hyperbola referred to its asymptotes as axes (*1b*).

Curves based upon Equation 3 have fitted the experimental points over a wide range of hemolysin quantities but deviate somewhat when low concentrations of the reagent are used.

TABLE 1

EFFECT OF HEMOLYSIN CONCENTRATION UPON THE CONSTANT, 1/n, IN VON KROGH'S ALTERNATION FORMULA

x Hemolytic antiserum (ml. × 10^{-4})	0.50	0.75	1.0	1.5	2.0	3.0	4.0	6.0	8.0
y 50% unit of complement (ml. × 10^{-3}) (calculated*)	29.41	7.98	5.85	4.62	4.18	3.81	3.65	3.51	3.44
1/n	0.366	0.354	0.254	0.221	0.199	0.175	0.166	0.180	0.199
Complement required for 99% hemolysis (ml. × 10^{-3}) (calculated†)			18.79	12.76	10.43	8.51	7.83	8.03	8.20

* Values of y from Equation 3, where b = 0.308 and a = −0.137.
† From the Von Krogh formula (*4*).

It is of interest that the highest concentrations employed failed to produce an inhibition of complement activity such as has been ascribed to agglutination of erythrocytes by concentrated antiserum. Such inhibitions have, nevertheless, been observed occasionally in previous experiments, and Equation 3 would not be expected to express the complement-hemolysin relation in the affected range.

The data were also examined with regard to the effect of

[1] With the technical assistance of Helen M. Conway and Willie Mae Bodie.

[2] As a result of consultations with W. R. Thompson, of the Division of Laboratories and Research, New York State Department of Health, it appears that a better fit may be obtained with the more general form of rectangular hyperbola, $(x - x_0)(y - y_0) = k$, where x_0, y_0, and k are parametric constants. The application of this formula will be discussed in a more comprehensive report.

emolysin concentration upon the slope of the hemolytic curve. he parametric constant, 1/n, in Von Krogh's alternation ormula (*4*) was taken as the index of slope, and its values were etermined, by the method of least squares, at the same time those of the 50 per cent units of complement (*2*). It was bserved that 1/n approaches a minimum in a central range hemolysin concentration and increases progressively with he use of greater or lesser amounts of the reagent. Table 1 ives the values obtained in the experience illustrated by ig. 1. More pronounced increases of the slope parameter ere observed in the presence of concentrated hemolysin when ntisera of higher titer were tested.

In an attempt to estimate the influence of this variable in etermining the least quantity of complement which may afely be used in complement-fixation tests, the amounts of complement which would be required for 99 per cent hemolysis ere calculated from the Von Krogh formula by substituting he predetermined values of 1/n and the 50 per cent units of complement. Estimates obtained in this manner are included n Table 1. In general, the concentration of hemolysin requiring minimum amount of complement for 99 per cent hemolysis orresponded closely with that exhibiting a minimum value of 1/n. It is noteworthy that both minima were observed in the ange of hemolysin concentration which has been taken as ptimal for the complement-fixation reaction (*5*).

The application of the foregoing criteria in the standardiza- ion of hemolysin is being studied. Equation 3 would permit he objective definition of an optimal concentration for com- lement-fixation tests.

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Reduction in the Vital Capacity of Asthmatic Subjects Following Exposure to Aerosolized Pollen Extracts

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The difficulty of determining the allergic factors responsible for asthmatic attacks is well recognized. Skin tests are frequently of little value for two reasons: first, because intense reactions in the skin may be produced by extracts of pollens or other substances which apparently are not factors in the production of the asthmatic attacks; and second, because many individuals with asthma do not show skin reactions to allergenic extracts.

A new approach to the study of asthma and the problem of determining the specific causes of asthmatic attacks was suggested by the demonstration that in the great majority of asthmatic subjects a reduction in vital capacity follows the parenteral administration of histamine or mecholyl (*1*). In the study to be described here, these changes in vital capacity were observed to follow inhalation of one or more extracts of birch, oak, grass, and ragweed pollens and certain other substances in 6 or 7 asthmatic subjects studied. Exposure to the aerosol was obtained by 15 or less deep inhalations of aerosolized extract from a small hand nebulizer attached to a tube with oxygen flowing at a rate of 6 l./minute. The nebulizer was held in front of the open mouth of the subject during the inhalations. Aerosols of the extracting fluid used in the preparation of the allergenic extracts failed to produce changes in vital capacity. Reductions to as little as 60 per cent of the control values have been produced by the pollen extracts, and in no instance has there been any associated reaction other than cough, a tight feeling in the chest, and symptoms of hay fever. These sensations were, according to statements made by the patients, identical with spontaneously occurring attacks of hay fever or asthma. Physical signs of asthma appeared with the more marked reductions in vital capacity but were never striking with the dosages used.

In those instances in which a reduction in the vital capacity followed inhalation of an aerosolized extract, the maximum decrease usually occurred between 6 and 10 minutes after exposure. In all patients but one the vital capacity returned to the control value within 50 minutes.

We have no reason to doubt the reliability of this method of testing for specific factors in asthma. In the patients studied to date, substances which produced a fall in vital capacity have always been of clinical significance as judged by the patients' histories and skin tests. Nevertheless, sufficient data to determine the value of the test in diagnosis are not available at the present time. Substances which were suspected of being clinically important have not always produced a fall in vital capacity. Furthermore, the method is time consuming, requires the cooperation of the patient, and is hampered at the present time by the lack of any accurate means of measuring the intensity of the exposure to the aerosol. Although cough and severe symptoms of hay fever may follow exposure to an aerosolized extract and may interfere with the measurement of the vital capacity, this has not been frequent in our experience, even when a marked decrease in vital capacity occurred. As such symptoms are clearly allergic in origin, their appearance may be helpful in diagnosis.

In spite of the disadvantages mentioned above the method appears to be very promising for the following reasons: (1) Reductions in vital capacity can be safely induced in the laboratory in asthmatic subjects by substances known to be capable of producing asthmatic attacks; (2) the lung, the chief site of the disease process, serves as the test organ; (3) the effect of various drugs in preventing or modifying changes in vital capacity following exposure to aerosolized extracts can be readily studied; and (4) the method affords an objective test in many instances because a considerable decrease in the vital capacity may occur without awareness on the part of the subject that a reaction to the inhaled extract is taking place.

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IN THE LABORATORY

A Method for Reclaiming Dried Zoological Specimens

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In most zoological laboratories alcoholic specimens which have dried out are discarded, regardless of their original significance. Material of distinct taxonomic value and critical specimens on which distribution records are based are often included in the losses to which laboratory collections are exposed, in spite of improved types of containers and systematic replacement of preservatives. Various methods have in the past been suggested as a means of reclaiming and at least partially restoring accidentally dried specimens. Potassium hydroxide and lactic acid are two reagents which have been used with some success on certain kinds of dried specimens, especially on some arthropods and nematodes. Both of these chemicals have definite limits to their usefulness, however. Caustic potash has the very real disadvantage of destroying tissues.

In this laboratory it was discovered a few years ago that commercial grade of trisodium phosphate in aqueous solution alters the permeability of membranes of preserved specimens of various invertebrates. This chemical has been of great value in treating specimens of parasitic worms to ensure free passage of fluids through the body wall when permanent whole mounts are being prepared. It has been observed that specimens which have become hardened and somewhat shriveled in the preserving medium become softened and pliable in trisodium phosphate. The specimens also become somewhat plumped but show no evidence of unnatural swelling. Furthermore, treatment with this chemical does not destroy the internal tissues. It thus has a very distinct advantage over caustic potash.

The highly satisfactory results obtained from the use of trisodium phosphate on small objects suggested the possibility of using this detergent for recovery of larger specimens which had become useless through drying. In numerous preliminary tests various kinds of dried animals have been subjected to the action of trisodium phosphate, and in most instances the results have been extremely gratifying. The results are not uniform for all kinds of dried specimens treated, but in every instance the reclaimed specimens showed restoration of general body form and revealed details of diagnostic characters which had been wholly unavailable in the dried specimens and in those treated with water or alcohol alone.

Trisodium phosphate becomes effective on dried specimens at low concentrations. A very dilute solution working for a long time seemed to be as satisfactory as a stronger solution for a shorter period. In routine procedure, quantities of the chemical were not measured, but it was later found that 0.25 to 0.5 per cent of commercial trisodium phosphate in distilled water was effective in restoring the appearance of specimen treated. Warmed solutions were more rapid in their actio than cold. In many instances, with small or originally delica objects, the maximum effect was obtained in about one hou although longer treatment continued to soften tissues a make the specimens more pliable. Some leeches that had be dry for several years were placed in trisodium phosphate in a oven at 35°C. After about an hour most of the extern features had been restored to normal appearance, and aft two days the leeches were relatively soft and pliable witho showing any evidence of dissociation of the tissues.

Insect nymphs and delicate crustaceans which had bee completely dried out in storage vials were restored to condi tions wherein all characters needed for classification wer observable. Dried centipedes and millipedes had all th shriveled appendages restored to condition fully available fo identification. A preserved sample of fresh-water plankto which had been dry in a bottle for more than two years wa covered with warmed trisodium phosphate. Less than on hour thereafter five species of cladocerans, two species o copepods, and several species of shelled rhizopods were al readily determinable.

A small minnow infected by a large liguloid tapeworm ha dried to badly shriveled condition and chalky whiteness. Treatment with trisodium phosphate restored general externa appearance of the fish, and the coils of the cestode were readily observable through its body wall.

Many other discarded objects have been reclaimed by this simple process. Perhaps the most striking example is a col lection of relatively large nematodes which had been dry for many years. Some of these worms were reclaimed while the others were left dry for comparison. Samples of the reclaimed specimens were stained and mounted by the usual procedure for making microscopic mounts. These show details of buccal armature, form and structure of the esophagus and pharynx, and details of the uterine coils.

Vacuum Infiltration as a Method for Determining Enzymic Activity *in Vivo*

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The usual method for the study of enzymes is to extract them from macerated tissues and observe their activity in a controlled medium outside living cells. Shortly before the war there appeared in Russian literature a description of a method for the determination of the activity of enzymes inside living cells. This was based on the vacuum infiltration of living cells with an enzymic substrate and on subsequent determination of what is left of it after a period of time. In the original

ethod living tissues were infiltrated with a solution of either vert sugars or sucrose, and the rates of sucrose synthesis or ydrolysis were determined (*1*). Later on this was extended r the determination of the activity of phosphatases (*6*) and lso for the synthetic activity of proteases (*3*). In the hands of Russian investigators these methods, and particularly the riginal one, have proved to be useful tools in several fields of hysiological investigations. It was thought, therefore, that a rief description of the method itself, together with a few esults obtained so far, might be of interest to workers on this ontinent.

The technique of the original method is as follows: Three mparable samples of leaves are placed separately in 150-cc. eakers. One sample is covered with distilled water and serves s a control. The second sample is covered with a 0.1 M solu- ion of sucrose, and the third with a 0.2 M solution of invert ugars. The beakers are placed in a desiccator and evacuated own to 20–40 mm. of pressure. When the stream of air ubbles from the leaves has ceased, the air pressure is slowly rought to normal, and the leaves become infiltrated with he surrounding solution. They are then removed from the olution, dried, left for a few hours at room temperature, and t the end of this period analyzed for their sugar content. rom the difference between the sucrose contents of leaves nfiltrated with invert sugars and of those infiltrated with istilled water, one obtains the amounts of sucrose synthetized n leaves during this period of time. In a similar manner, the ifference between the invert sugar contents of leaves in- iltrated with sucrose and of those infiltrated with distilled ater gives the value for the amounts of sucrose hydrolyzed.

A sample of calculations follows. Leaf samples were in- iltrated with distilled water, invert sugars, and sucrose and, hree hours after infiltration, were analyzed for various forms f sugar. The results of the analysis are given in Table 1.

TABLE 1

SUGAR CONTENT OF LEAF SAMPLES EXPRESSED AS MG. OF GLUCOSE/1 GRAM OF LEAF DRY WEIGHT

	Invert sugars	Sucrose	Total sugars
(1) Control	32.8	18.4	51.2
(2) Infiltrated with 0.2 M invert sugars	125.0	35.6	160.6
(3) Infiltrated with 0 1 M sucrose	67.2	97.3	164.5

Invert sugars in the amount of 109.4 mg. were infiltrated into Sample 2, and 113.3 mg. of sucrose into Sample 3. In Sample 2, 17.2 mg. (35.6 − 18.4) of sucrose, or 15.7 per cent of the amounts introduced, were synthetized. In Sample 3, 34.4 mg. (67.2 − 32.8) of sucrose, or 30.5 per cent of the amounts introduced, were hydrolyzed. Calculated per hour per gram dry weight of leaf tissues, these rates become 5.7 mg. of sucrose synthesis and 11.5 mg. of sucrose hydrolysis. The synthesis: hydrolysis ratio of 5.7: 11.5 indicates a considerable excess of hydrolysis over synthesis.

It was found that in a given plant organ the synthesis: hydrolysis ratio does not remain constant but undergoes a series of diurnal and ontogenetic changes. Thus, it was reported that in the leaves of sugar beets (*12*) and in *Bromus* (*9*) this ratio increases in the forenoon, comes to a peak at noon, and then declines. This ratio is high in a young leaf and declines in an old one (*14*). Vernalization decreases the ratio in the leaves of both wheat and cotton and causes it to approach that of plants in more advanced stages of their development (*3*). In ripening fruits there is at first a short rise in the ratio, followed by a decline as a consequence of a considerable increase in hydrolysis and a drop in synthesis. These changes are accelerated by the ethylene treatment (*5*). In late varieties of plants the synthesis:hydrolysis ratio is higher than in the early ones (*3*, *10*, *11*, *13*). When in different varieties of onion bulbs, beet roots, and watermelon fruits the ratio is high, a greater proportion of their sugars is present in the form of sucrose (*10*).

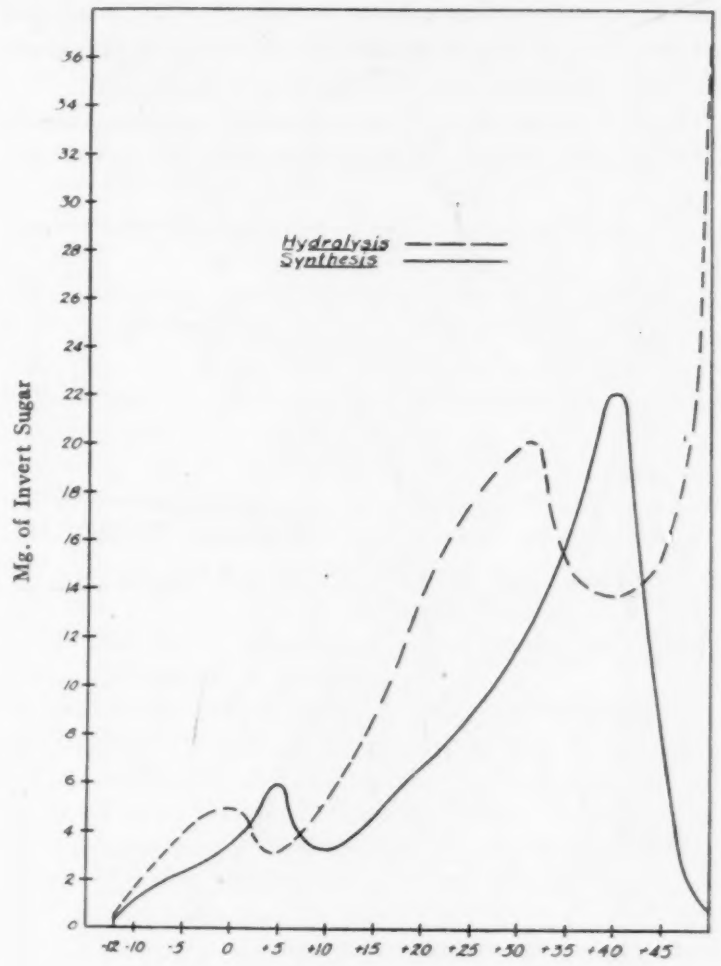

FIG. 1. Effect of temperature on the synthesis and hydrolysis in 25-day-old seedlings of winter rye. (Figure from paper by A. Kursanov, N. Krjukova, and A. Morozov, *8*.)

The effects of inorganic constituents on the enzymic activity within the living cells can be studied by either infiltration of tissues with such constituents or by using plants grown on deficient media. It was observed that the deficiency of phosphorus decreases the synthetic capacity of sugar beets (*14*) and chicory leaves (*16*). Simultaneously, the per cent of reducing sugars in the total sugar fraction is increased. The presence of potash was reported to stimulate synthesis in a number of plants (*4*, *18*). On the other hand, NaCl and $CaCl_2$ depress synthesis (*18*).

By keeping the leaf samples after their infiltration at different temperatures, the effects of this last factor were studied (*8*). The results obtained are shown in Fig. 1. From an examination of the figure it is seen that at the middle range of

temperatures there is a direct relation between temperature and either synthesis or hydrolysis. At both high and low temperature extremes there are, however, two short ranges of temperature, when the rates of synthesis are above those of hydrolysis. When a hardier and a frost-susceptible variety of Cinchona tree were placed for a short time at 0° C., there was a decrease in the absolute rates of both synthesis and hydrolysis in the leaves of both varieties. On return to a higher temperature with a hardy variety, this decline was found to be a reversible one, and this variety recovered. With a frost-susceptible variety the decline was found to be an irreversible one, and the plant died (*7*). On the strength of such experiments it was suggested that a low-temperature injury or even death in a plant may be a result of interference with the normal functioning of its enzymic mechanism. That a low-temperature injury may occur above 0° C. supports this contention.

The effects of decreasing water content of leaves on synthesis and hydrolysis were determined in wilting tea leaves (*2*).

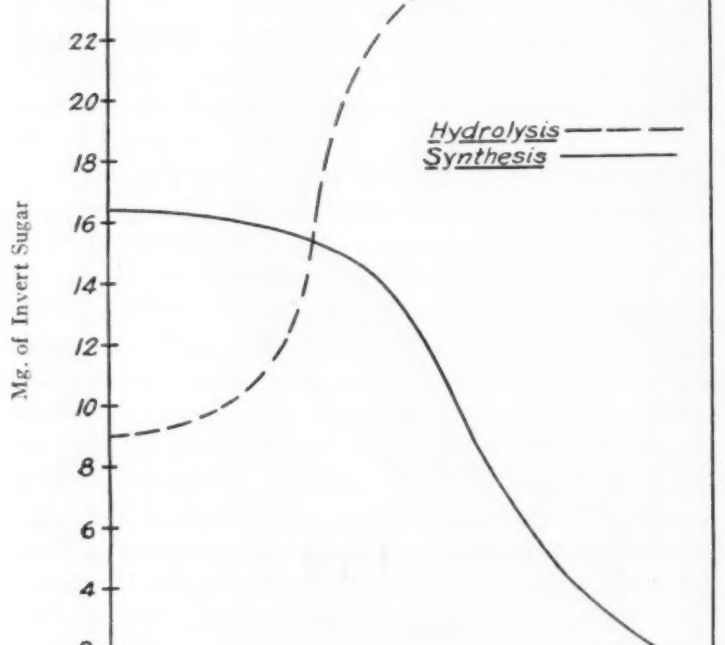

FIG. 2. Effect of water deficit on the synthesis and hydrolysis in tea leaves. (Figure from paper by A. Kursanov, *2*.)

Fig. 2 gives the data obtained. It is seen that a decrease in the water content of leaves results in a decrease in synthesis and an increase in hydrolysis. The two graphs are approximately mirror images of one another. Though the initial synthesis: hydrolysis ratio is higher in the leaves of drought-susceptible than in those of the resistant varieties of wheat, under the conditions of wilting this ratio drops off more rapidly in the former varieties than in the latter (*15*). The same was reported for the synthetic and hydrolytic action of proteases (*17*). It was suggested that the absolute value of this ratio, and the rate of its fall under the conditions of wilting, may be used in diagnosis of drought-resistant and nonresistant varieties of plants. This could be done even on plants which are in their seedling stage

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Action of Subtilin in Reducing Infection by a Seed-borne Pathogen

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Previous studies (*2*) at this laboratory have indicated that infection by certain seed-borne pathogens may be reduced by the antibiotic action of the natural microflora of the soil. More recently attention has been concentrated on individual antagonists from the soil, especially on those showing evidence of producing antibiotic substances capable of preventing seed-borne pathogens from producing infection. A survey for such organisms in Alberta soils, conducted in collaboration with A. W. Jackson, resulted in the selection of *Bacillus subtilis* Cohn, emend. Prazmowski, as a promising antagonist. It proved to be particularly active in culture against *Xanthomonas translucens* (J. J. and R.) Dowson, a seed-borne bacterial pathogen which we had under observation. Moreover, subtilin, a known antibiotic substance (*3*) produced by *B. subtilis*, was found in plate tests to be active against *X. translucens*. Hence, this substance was chosen for the special study reported here, which has to do with the effects of subtilin on *X. translucens* and, in turn, on the disease which it produces in barley.[1]

The sample of subtilin used was kindly supplied by the Western Regional Research Laboratory of Albany, California, at the request of the National Research Council of Canada. A pathogenic strain of *X. translucens f. sp. cerealis* (*1*) was provided by W. A. F. Hagborg, of the Dominion Laboratory of Plant Pathology, Winnipeg. O.A.C. 21 barley was employed

[1] Financial assistance from the National Research Council of Canada is gratefully acknowledged.

s the host plant of the pathogen, and difficulties at first xperienced in infecting it by means of seed-borne inoculum ere largely overcome by the use of a modification of Wallin's 4) technique.

By making up the infestation medium with dilutions of ubtilin in distilled water it was possible to infest seed with *X. translucens cerealis* and treat it with subtilin simultaneously. The seed was treated under partial vacuum for 1 hour and hen allowed to soak in the medium for 20–24 hours. Prelimi-

TABLE 1

EFFECT OF DIFFERENT DILUTIONS OF SUBTILIN ON THE ABILITY OF *X. translucens cerealis* TO INFECT BARLEY SEEDLINGS

X. translucens cerealis in a dilution of:	Sterilized soil			Unsterilized soil		
	No. plants emerged	No. showing lesions	Diseased* (%)	No. emerged	No. lesioned	Diseased* (%)
1,000 subtilin	120	1	0.8	46	0	0.0
3,000 "	127	39	30.7	44	3	6.8
5,000 "	124	52	41.9	59	15	25.4
terile dist. H_2O	83	39	47.0	49	10	20.4

*$\frac{\text{No. of seedlings showing lesions}}{\text{No. of seedlings emerged}} \times 100$.

inary experiments had shown that subtilin had no injurious effect on seed when applied in this way. The treated seed was hen sown in 6-inch flower pots containing a 1:1 mixture of Edmonton black soil and fine sand. Twenty-five seeds were own per pot and 200 seeds were used per treatment. One eries was sown in steam-sterilized soil and another series in nsterilized soil. The pots were kept at 30° C. in constant-emperature chambers in the greenhouse for 10 days, after hich notes were taken on emergence and on the number of esioned plants. The results are presented in Table 1. The pots ere then left on a greenhouse bench for 10 days longer and a econd count then made. No increase in emergence occurred in he sterile series, but there was some increase in the unsterile eries. The second disease count gave results comparable to he first.

It will be noted from the above table that *X. translucens erealis* exposed to a 1:1,000 dilution of subtilin was largely nactivated as measured by its ability to cause infection in arley seedlings. Comparable infection trends were obtained n sterilized and unsterilized soil. The consistently lower ercentages of infection in the unsterilized as compared with he sterilized soil are probably attributable to the antibiotic ction of the natural soil microflora, as has been reported for ertain diseases of flax (*2*). The natural soil microflora is robably also responsible for the low degree of emergence in he unsterilized series, since the seed was sown in a soaked ondition and kept at 30° C., which would make it quite usceptible to such action. The infection ratings in the test ere based on the number of seedlings emerged. It has been hown by Wallin (*4*) and confirmed by our experiments that *X. translucens* causes a reduction in emergence of barley. Had our infection ratings taken reduced emergence into consideration, they would have been still more striking.

The results of the above experiment show that subtilin is effective in reducing infection of barley by *X. translucens cerealis* when applied as indicated at the time of infestation of the seed. It is desirable to know whether it can destroy inoculum applied to the seed before as well as at the time of treatment. Other experiments at this laboratory had shown that seed artificially infested with *X. translucens cerealis* and then

TABLE 2

EFFECT OF TREATING BARLEY SEED, ARTIFICIALLY INOCULATED WITH *X. translucens cerealis*, WITH A 1:1,000 DILUTION OF SUBTILIN

Treatment	Seedlings emerged	Seedlings lesioned	Diseased (%)	Emergence (%)
Vacuum, 1 hr.; soaked, 20–24 hrs.	165	29	17.6	47.1
Vacuum, 15 min.	261	90	34.5	74.6
Check	249	103	41.4	71.1

dried would still produce infection when sown. Accordingly, seed was artificially infested with *X. translucens cerealis* alone and then dried for 4–5 days at room temperature. This preinfested seed was then treated with 1:1,000 subtilin by two methods: (1) under partial vacuum for 1 hour and then allowed to soak in the solution for 20–24 hours, and (2) under partial vacuum for 15 minutes. The seed thus prepared, together with an untreated check, was then sown at the rate of 350 seeds per treatment in a 1:1 sterilized soil and sand mixture and kept at 30° C. in constant-temperature cabinets in the greenhouse. Emergence and disease counts, taken 7 days later, are presented in Table 2.

These results show that subtilin will act to reduce infection when applied to seed artificially infested with *X. translucens cerealis* before treatment. The low emergence in the first treatment is probably due to the effect of the two rather severe vacuum treatments, one during the infestation and the other in the application of subtilin.

It is not implied that the results here reported are immediately applicable in the practical treatment of seed. However, they do indicate that seed treatment with antibiotics may, with future refinements of technique, have some possibilities of a practical nature.

The methods used here would seem to provide results that are more reliable for assessing the practical value of antibiotic substances to be used against seed-borne bacterial pathogens than are those obtainable from plate tests. Limitations of materials have so far prevented the use of other methods of determining the practical value of subtilin in relation to the treatment of seed.

References

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Book Reviews

Human genetics. Vols. I and II. Reginald Ruggles Gates. New York: Macmillan, 1946. Vol. I: Pp. xvi + 742; Vol. II: Pp. vi + 743–1518. (Illustrated.) $15.00 per set.

Prior to the publication of these two volumes there existed no truly comprehensive reference work dealing with the subject of human inheritance. Except for the genetics of the human eye, skin, blood groups, twinning, and a few other topics, where more extensive summaries are available, *Human genetics* provides the most complete compilation now available on many aspects of human heredity.

The first four chapters cover a general ground: "Introduction," "General Principles of Heredity in Man," "Human Cytology," and "Linkage." The remainder deal with abnormalities of the various organ systems, with normal or anthropological variations, and with special topics, such as allergy, cancer, constitution and disease susceptibility, mental defect, syndromes, metabolic errors, normal mental differences, etc.

In considering the merits of Dr. Gates's work, one must keep in mind some of the peculiarities of the study with which he is concerned.

There is, first, the enormity of the subject. Man is an extremely variable species, and this variability has been recorded in a medical and biological literature of gigantic proportions. An illustration may be of interest. In his chapter on abnormalities of the eye, the author summarizes the literature on approximately 100 hereditary anomalies. One of these (Marfan's syndrome) is associated with skeletal changes and is described in another chapter, where references are made to 25 papers. A recent review article on this syndrome cites 192 publications.

The literature is not only large but elusive, for human heredity has remained largely an incidental study, and titles of medical papers frequently give no clue to their genetic contents. The extensive bibliography therefore makes this a most useful work, and this feature has been well done. The lists of references apportioned to the 31 chapters cover 243 pages and provide complete title and page citations. There is also a very full index of 90 pages.

Since most medical texts contain rather meager references to heredity, the chapters on pathological inheritance will doubtless prove of greater value than the others. Here the medical specialist may find convenient summaries on the genetics of such everyday problems as hypertension, dental caries, breech presentation, or susceptibility to poliomyelitis, or equally, of such oddities as the Marcus-Gunn phenomenon, auricular appendages, or Pelger's leucocyte anomaly.

For the most part, the text consists of an unbroken series of abstracts of papers and citations of pedigrees. Wherever possible, the author calls attention to problems of genetic physiology, and he incorporates a valuable feature in the frequent reviews of certain hereditary abnormalities in animals which resemble those of man. However, the inadequacies of the data bearing on many problems in human genetics have tempted the author to speculate quite freely on modes of inheritance, linkage relationships, rates of selection, mutation, etc. The following excerpts occur in the chapter on albinism.

"Complete albinism appears to be found in all races, perhaps represented by the same gene. But the frequency of this gene varies greatly, from perhaps 7 per 1000 in the San Blas Indians of Darien to 5 per 1000 in the Hopi Indians, 1 per 10,000 in Norway, 1 in 29,000 in Italy and 1 in 100,000 in France and Russia. This may depend on differences in the mutation frequency, but as to the causes of such differences there is no evidence at the present time. That they exist must, however, have some evolutionary significance. It supports the general view (Gates, 1936) that differences in mutation rates arise within a species or group of related species. . . . There may be a greater frequency of albinism in very fair families but albinos also arise from parents with dark brown or black hair. Possibly blond hair is genetically linked with the gene for albinism. . . . From these and other records it is clear that albinos of the colored races generally have more iris pigment than albinos of the white race. They are probably recessive in inheritance, but in the light of Zimmermann's records some of them might be dominant. They are by no means a uniform group but probably a series of alleles, some of them illustrating how the white race arose from colored ancestors."

In the figures cited, the incidence of albinism is incorrectly described as the frequency of the recessive gene, while the remainder of the passage reveals a mixture of uncritical review and surmise, which characterizes many sections of the text. By repeatedly offering genetic linkage as an explanation for genetic correlations of all kinds, the author perpetuates a widespread misconception that these two terms are synonymous. His chapter on linkage contains no clear explanation of autosomal linkage or examples of its statistical detection, but there is appended a list of 48 "probable or possible" autosomal linkages, which in most cases are based on statements similar to the above.

There is, indeed, a conspicuous dearth of quantitative reasoning and statistical method throughout, a lack which seems particularly unfortunate in any treatise on human heredity. For such a work is likely to be consulted by many who are unfamiliar with the usual requirements of statistical analysis in genetics, let alone the more complicated procedures which are made necessary by the peculiarities of human data.

Human genetics is, thus, a descriptive account of a science which is still largely in the descriptive phase of its development. The chief value of these two volumes lies in their comprehensive treatment of a vast and little-summarized literature. They encourage the student to think about problems in cytology, physiology, and population genetics, but in the last-mentioned field, they provide him with no better guide than that of conjecture.

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